

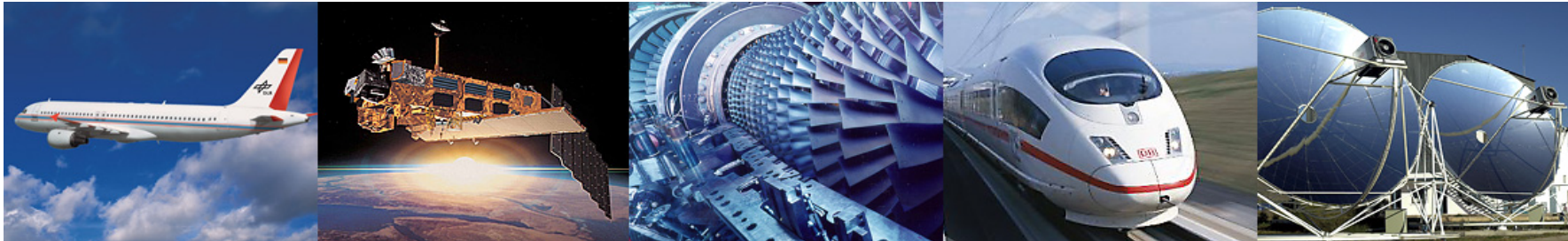
# DLR Simulation and Software Technology

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German Aerospace Center (DLR)



## DLR German Aerospace Center



- Research Institution
- Space Agency
- Project Management Agency



## Locations and employees

7400 employees across  
32 institutes and facilities at  
■ 16 sites.

Offices in Brussels, Paris,  
Tokyo and Washington.





## Research Areas

- Aeronautics
- Space Research and Technology
- Transport
- Energy
- Defence and Security
- Space Administration
- Project Management Agency





# Simulation and Software Technology

## Central institution with competency in software

- Research in computer science and software technology
- Software development

## Located in

- Berlin
- Braunschweig
- Cologne



## DLR bodies

Space Committee

### General Assembly

### Senate

Chairman: State Secretary of the Federal Ministry of Economics and Technology (Herkes)

Scientific Technical  
Council

### Executive Board

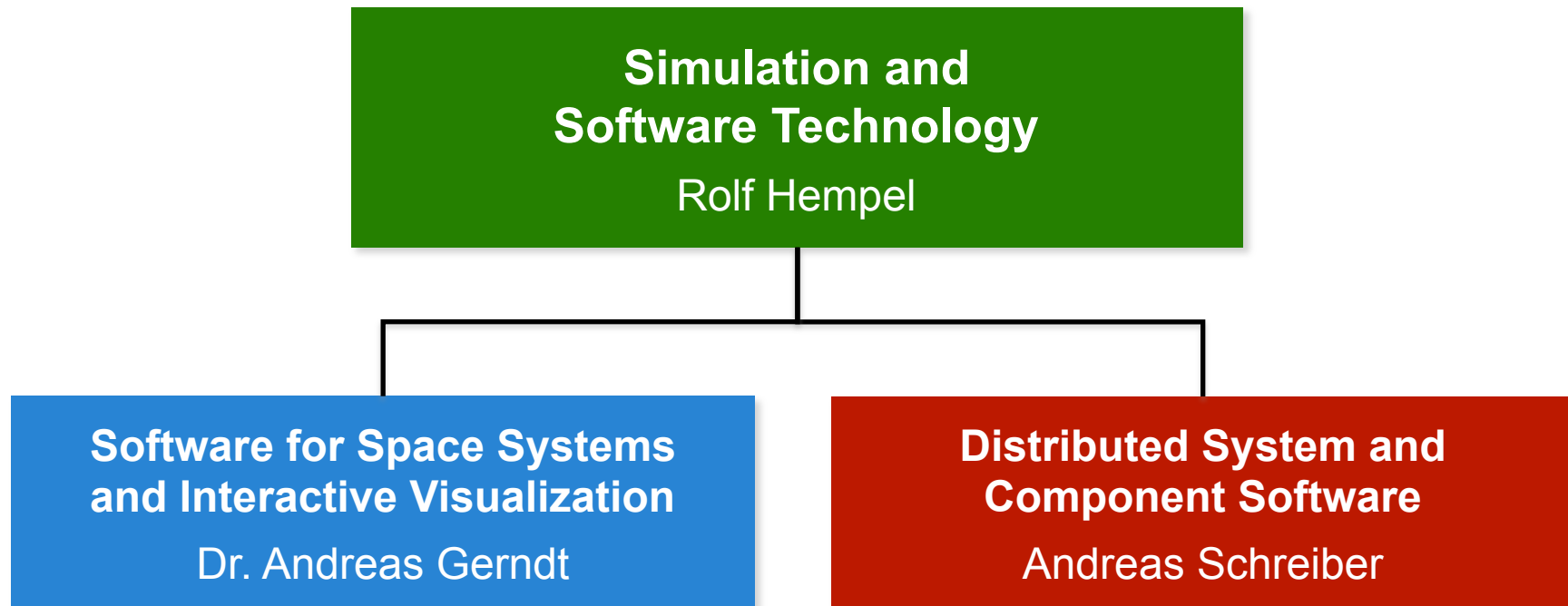
|   |   |  |  |  |  |
|---|---|--|--|--|--|
| Chairman<br><br>Prof. Dr. Wörner  | Vice Chairman<br>Administration/Technology<br>Marketing and Project<br>Management Agency<br><br>Hamacher  | Space Administration<br><br>Dr. Gruppe   | Space Research<br>and Technology<br><br>Prof. Dr. Dittus   | Aeronautics<br><br>Prof. Henke   | Energy and Transport<br><br>Prof. Dr. Wagner   |
| Strategy and<br>International Relations<br><br>DLR offices in Brüssel,<br>Paris, Washington<br>and Tokio<br><br>Corporate<br>Communications<br><br>Political and<br>Economic Relations<br><br>Executive Office<br><br>Capital Expenditure<br>Management<br><br>Program Coordination<br>Security Research<br><br>Education/ Outreach<br><br>Diversity and<br>Equal Opportunities | Finance and Corporate<br>Controlling<br><br>Human Resources<br>and Legal Matters<br><br>Management of Sites<br><br>Technical Infrastructure<br><br>Corporate HR Marketing<br><br>Internal Auditing and<br>Joint Venture Management<br><br>Technology Marketing<br><br>Quality and Product<br>Assurance<br><br>Information and<br>Communication Technology<br><br>Project Management DLR /<br>Agency Aeronautics<br><br>Scientific Information | Program Directorate<br><br>Project Directorate<br><br>Office of Management<br>and Budget | Cluster, Institutes and<br>Facilities Space<br><br>Program Directorate<br>Space Research<br>and Technology<br><br>Institute Development<br>Space | Cluster, Institutes and<br>Facilities Aeronautics<br><br>Program Directorate<br>Aeronautics<br><br>Institute Development<br>Aeronautics, Energy<br>and Transport | Cluster, Institutes and<br>Facilities Energy and<br>Transport<br><br>Program Directorate<br>Energy<br><br>Program Directorate<br>Transport |

update: 28.05.2013



# Simulation and Software Technology

## Departments

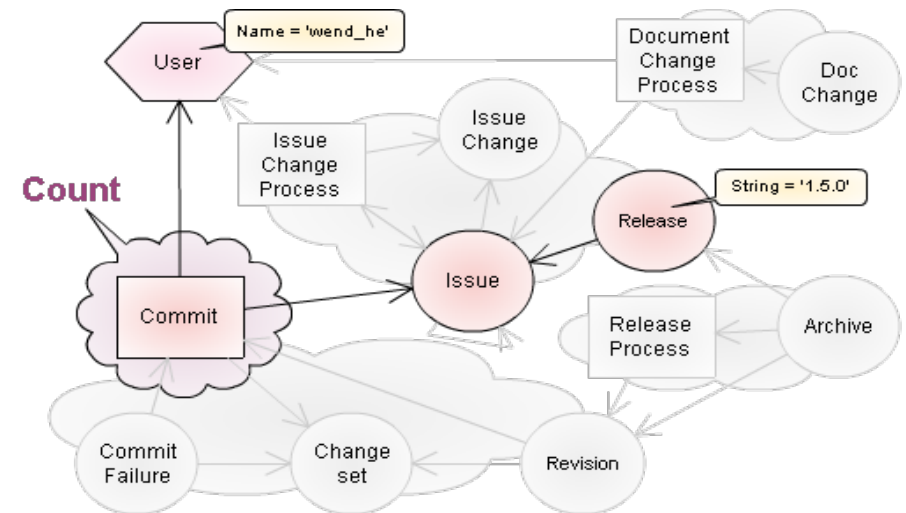




# We do Scientific Research in Computer Science

## Participation in international software research

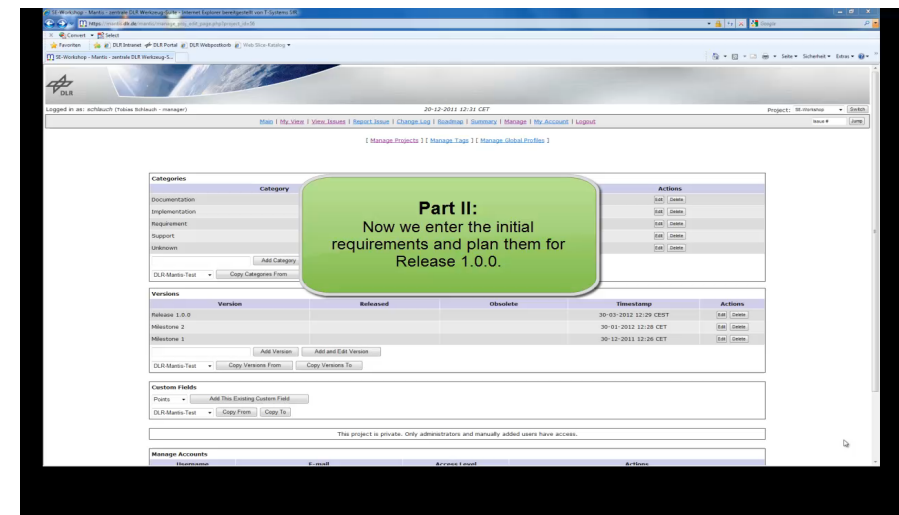
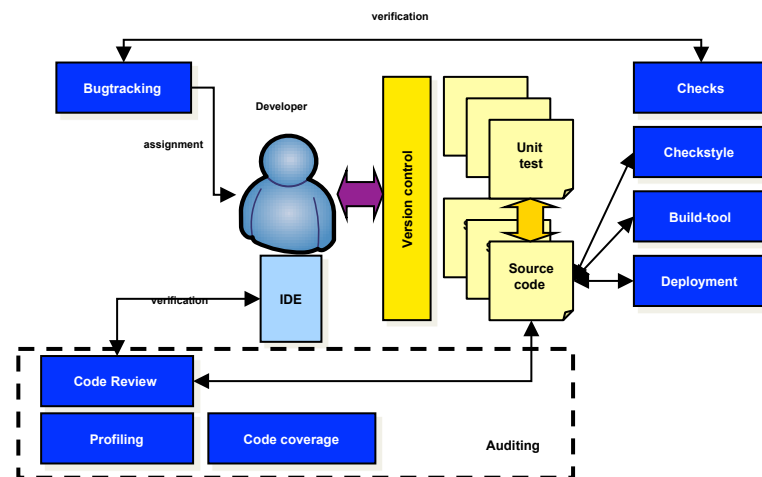
## To identify, explore, and develop new software technologies for DLR



# We develop and apply innovative software engineering techniques

Participation in DLR-internal projects and collaboration with users at engineering institutes

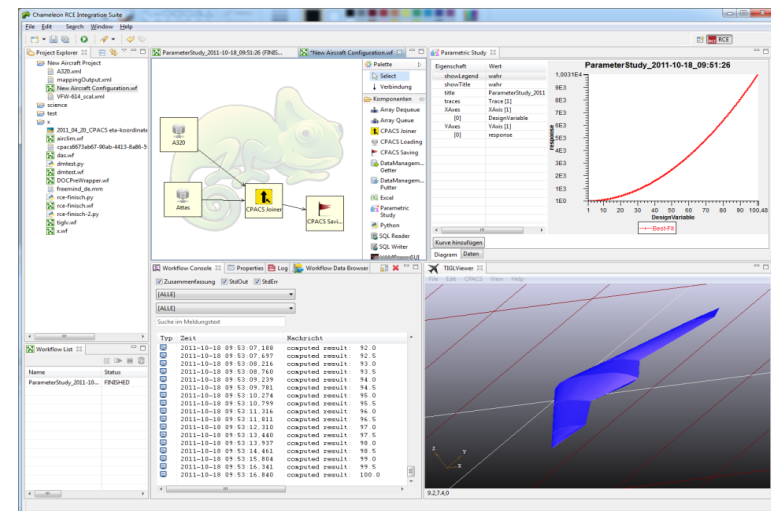
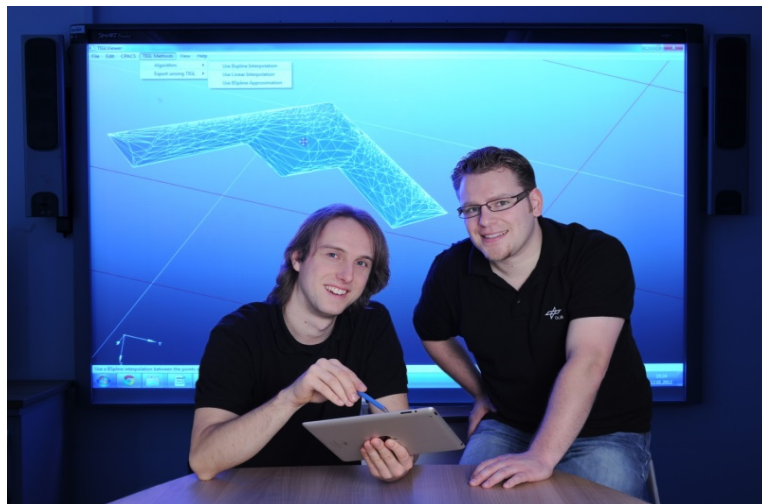
To enhance software quality at DLR



# We develop sophisticated software solutions

Application of innovative software technologies in challenging software projects at DLR

For all DLR research areas

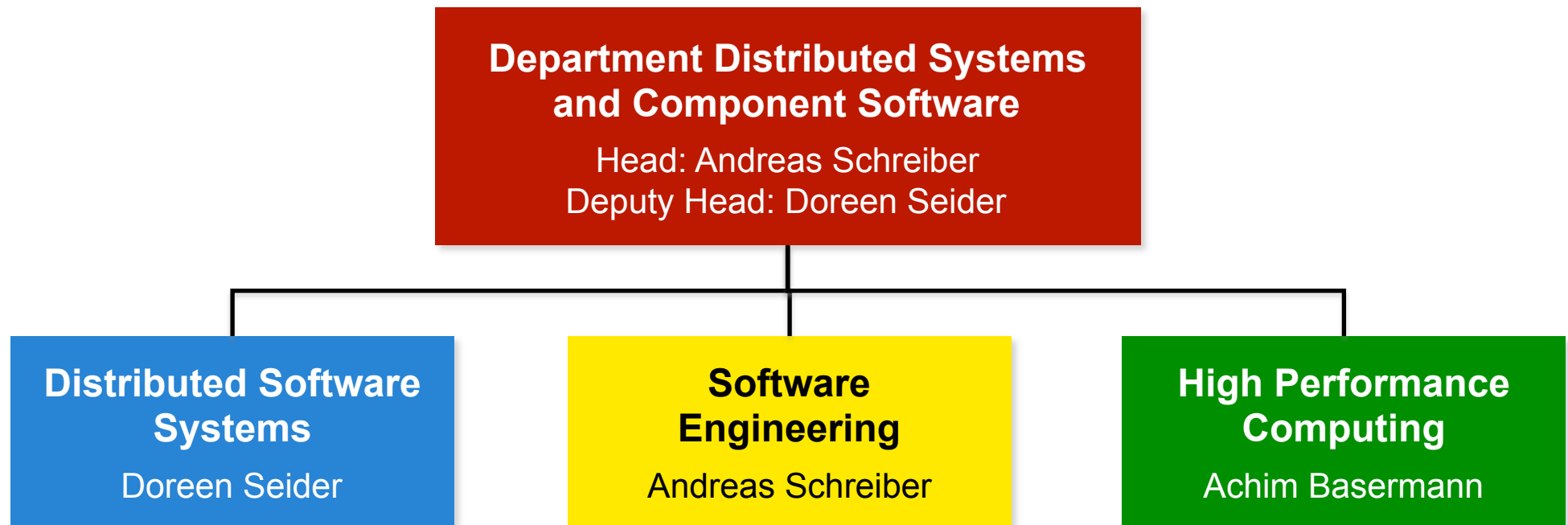




# Department Distributed Systems and Component Software



# Department Distributed Systems and Component Software



# Distributed Software Systems Group





# Distributed Software Systems Group

## Integration and Distributed Computing

### Integration of software (codes) and data

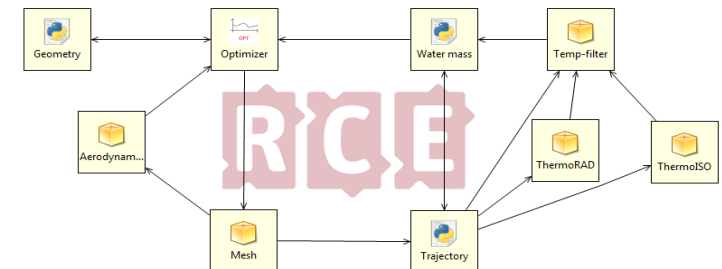
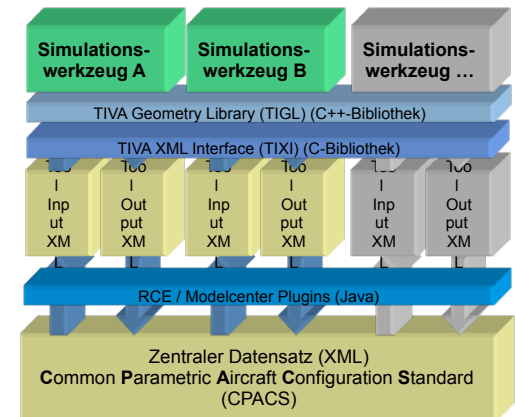
- Integration techniques, user interfaces
- Unified data interfaces for linking diverse disciplines

### Distributed computing / distributed components

- Distributed workflows
- Distribution of components
- Cluster-, Grid-, Cloud-Computing

### Development of integration frameworks

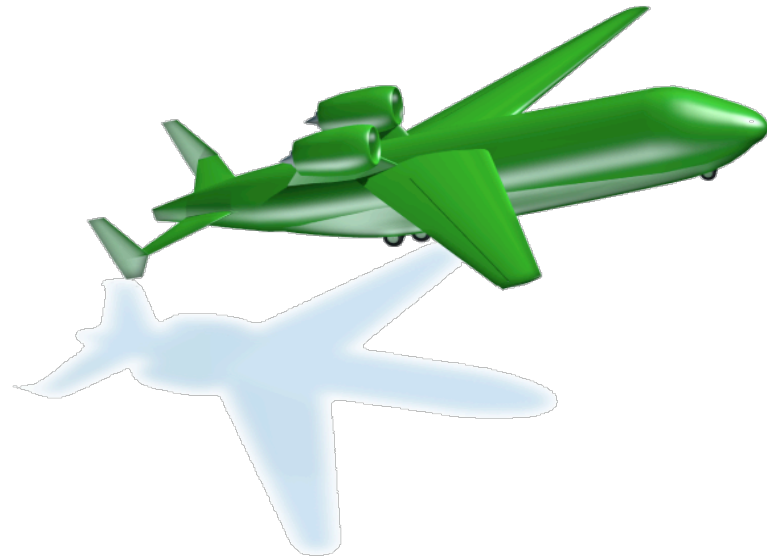
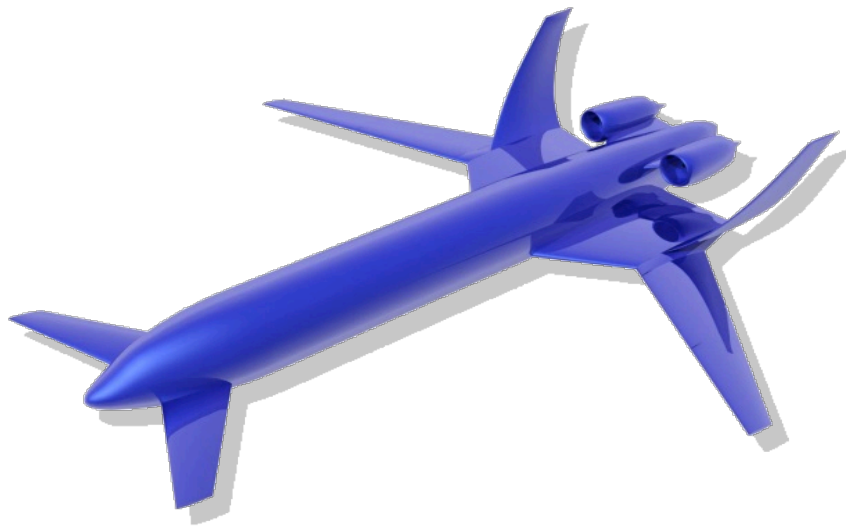
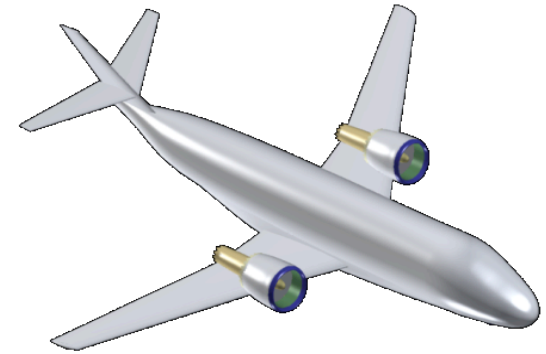
- Desktop and mobile systems
- MDO

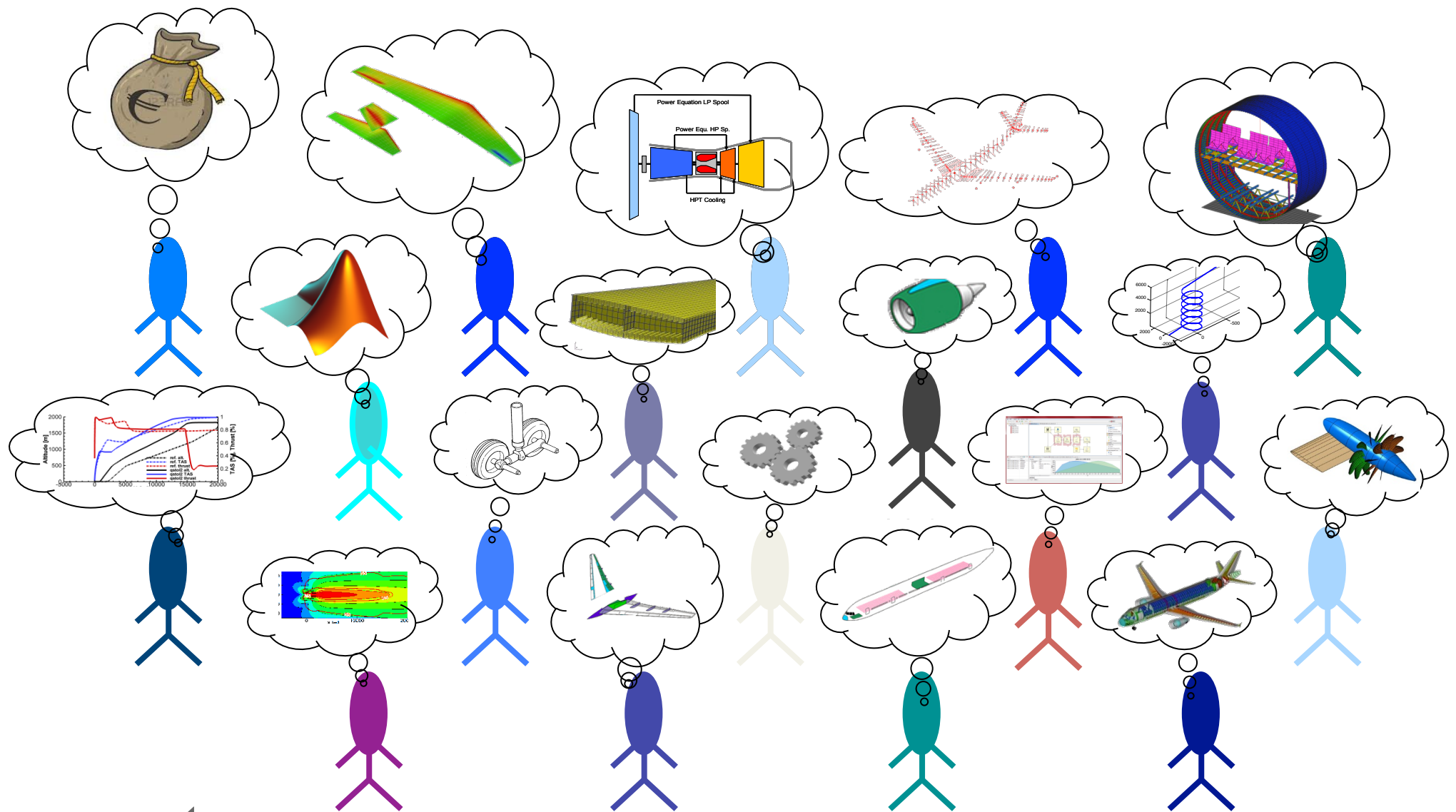


## Example Future Aircraft Design with RCE

**Get new aircraft configurations which**

- are more environment-friendly
- require less operating costs







## RCE: Software for Future Aircraft Design

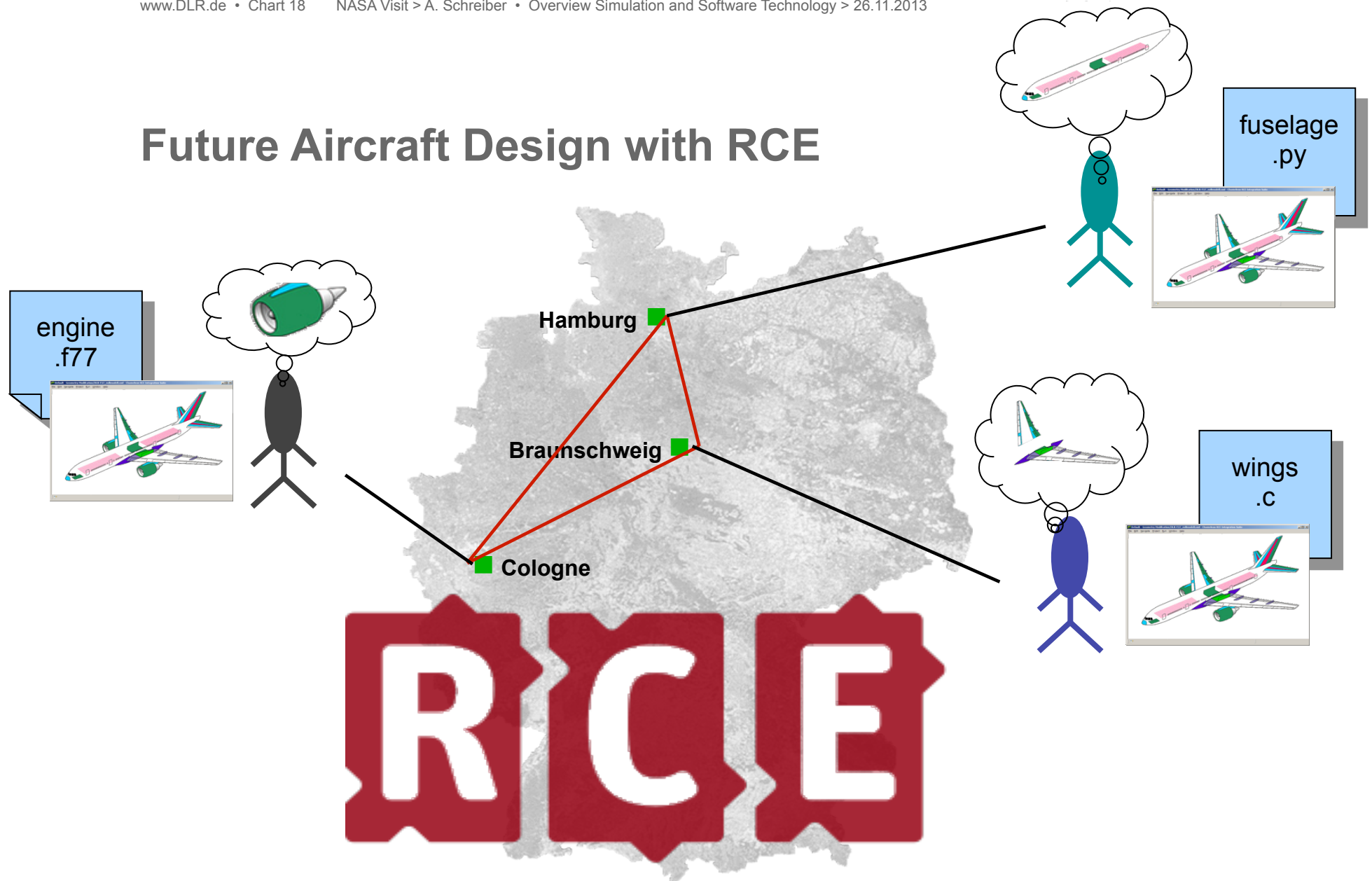
**DLR develops software for future aircraft design called RCE (Remote Component Environment)**

**RCE enables multidisciplinary collaboration to help experts from different disciplines to solve aircraft design task in common**

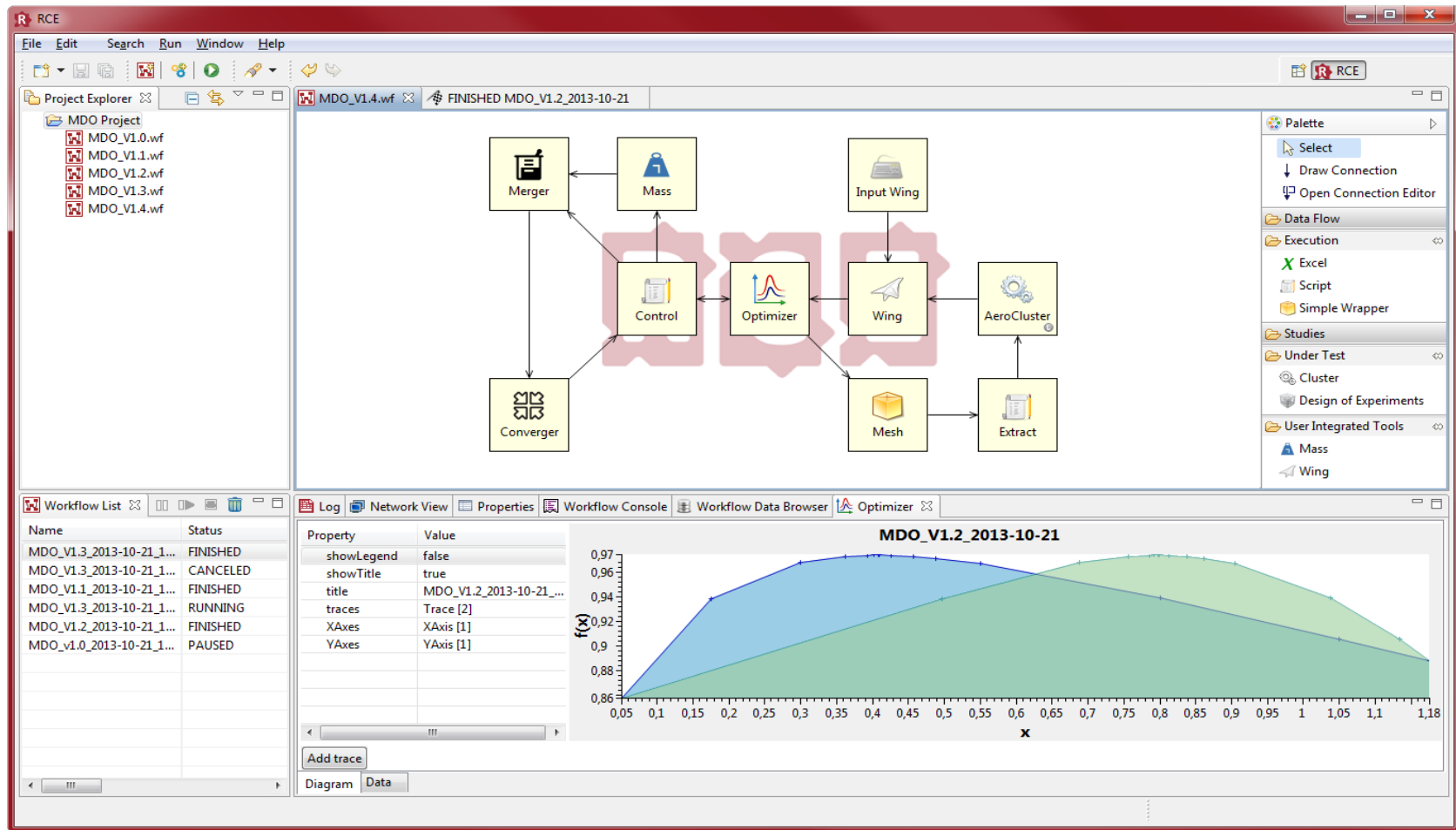
**We built RCE on Eclipse RCP and made it open source (EPL)**



# Future Aircraft Design with RCE



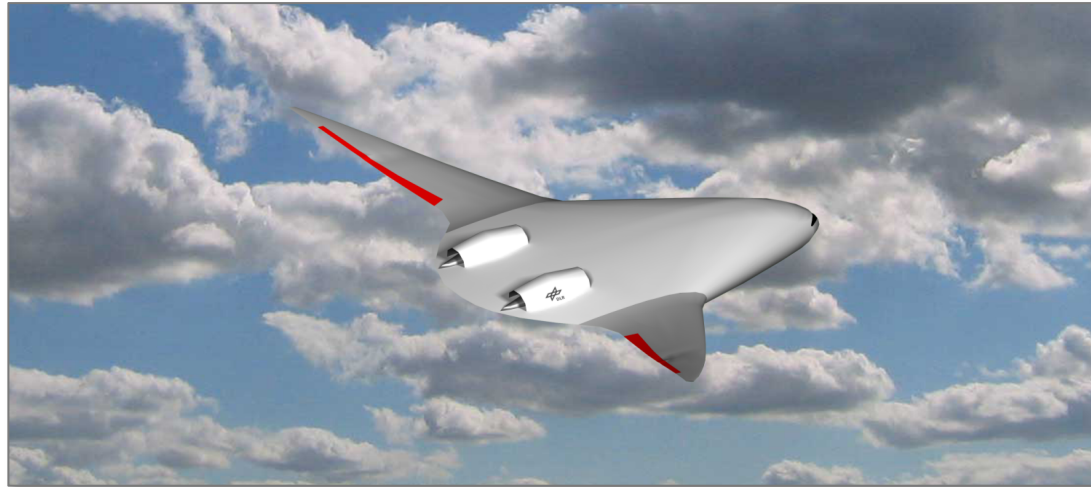
# Graphical User Client of RCE



## Current Projects at DLR: FrEACs

### Future Enhanced Aircraft Configurations

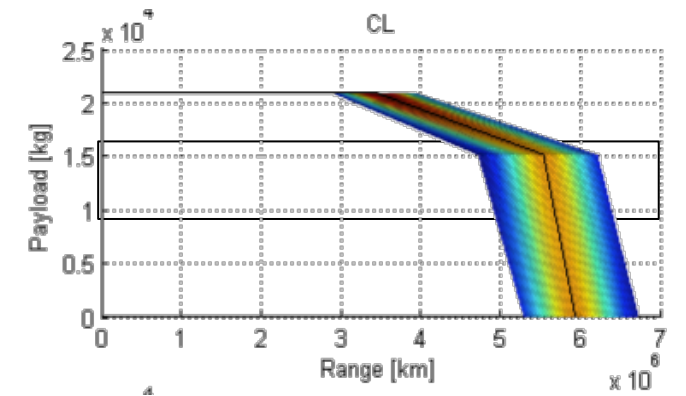
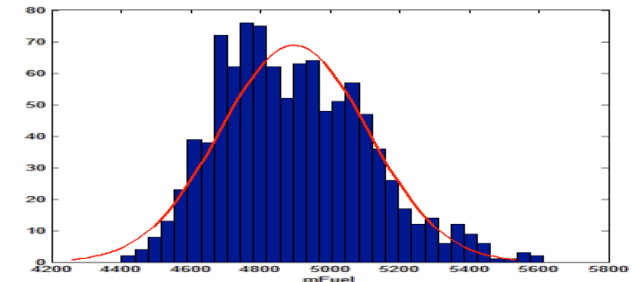
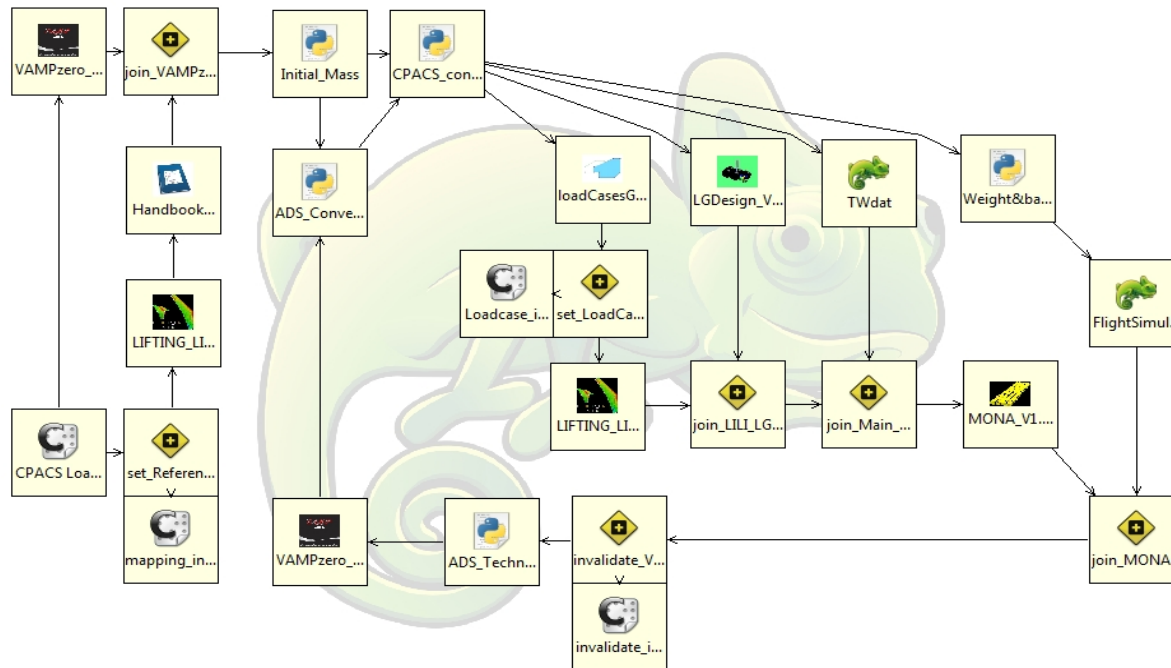
Evaluate new aircraft configurations such as the blended wing body aircraft





## Current Projects at DLR: FrEACs

Consider uncertainties in the workflow: How reliable are the results?



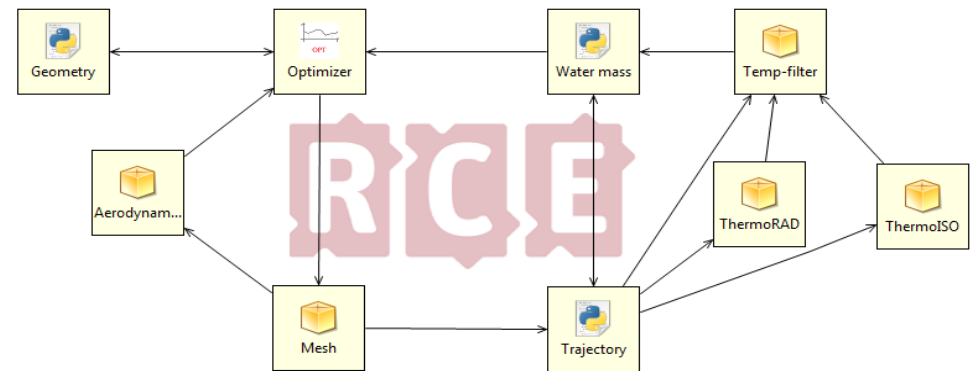
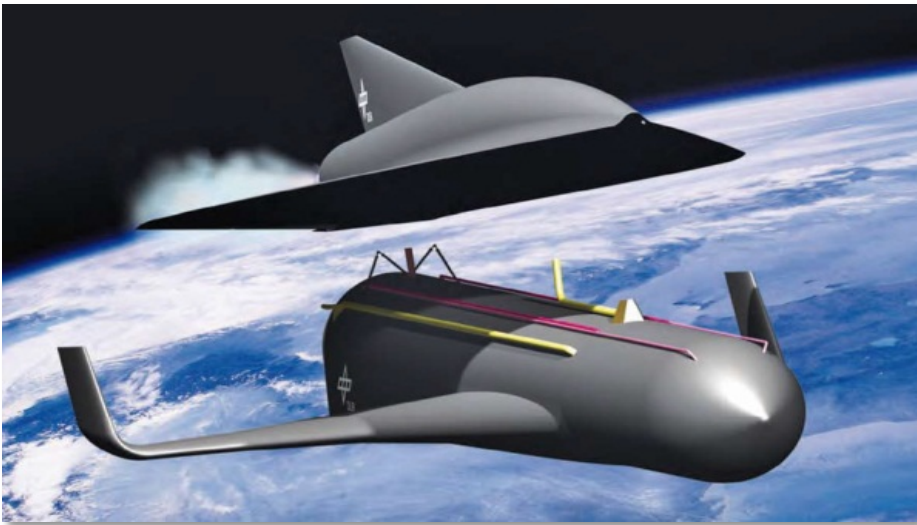
## Current Projects at DLR: FrEACs

Consider the human aspect in multidisciplinary collaboration



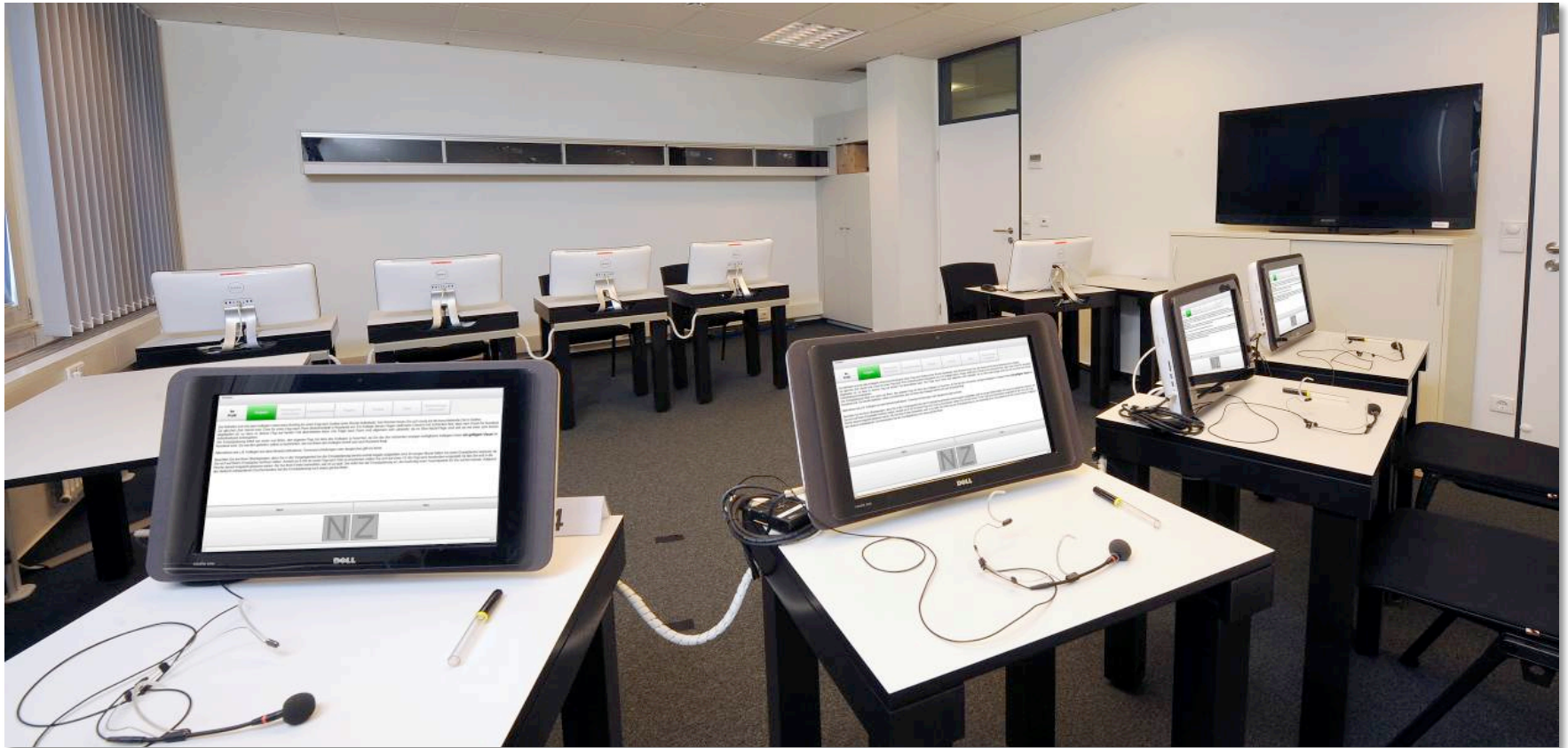
## Current Projects at DLR: THERMAS

Device thermal protection system of the SpaceLiner during atmospheric re-entry  
SpaceLiner is innovative concept between aviation and space travel for ultra fast passenger transport: Europe - Australia in 90 min





## Example Group Assessment of Performance and Behavior



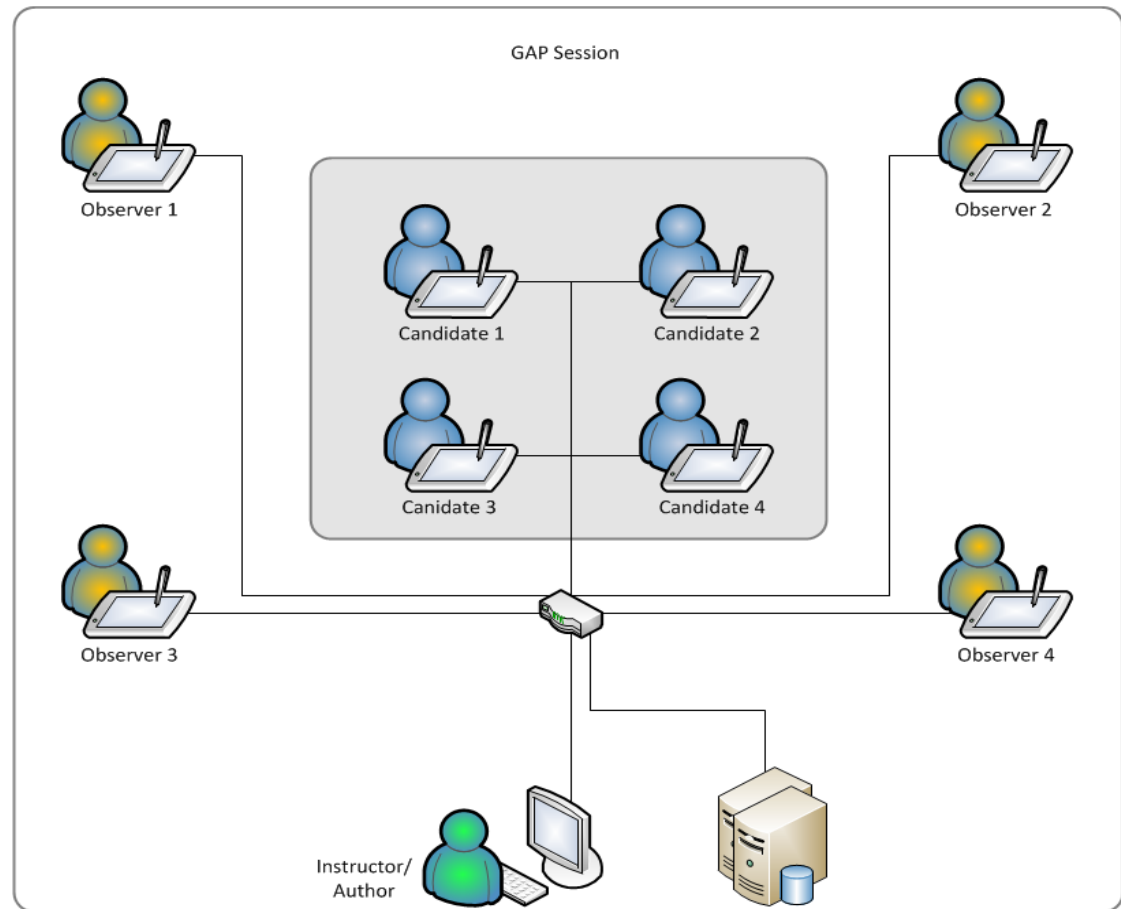


# GAP

## Group Assessment of Performance and Behavior

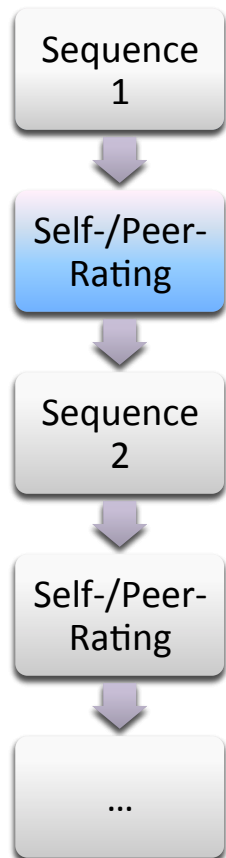
**Assessment center for  
pilot / astronaut  
applicants**

**Behavior diagnosis of  
people in small groups  
(3-6)**



# GAP Software (1)


## Candidate



GAP - Candidate Application

Messages:

**Selbst-bewertung** Flugbegleiter 2 Flugbegleiter 3 Flugbegleiter 4



**Führungs-kompetenz**  
↓ 2 ↑

**Communication**  
↓ 6 ↑

**Teamwork**  
↓ 3 ↑

**Strain Symptoms (para-)verbal**  
↓ 4 ↑

**Strain Symptoms motorisch**  
↓ 1 ↑

**Strain Symptoms vegetativ**  
↓ 4 ↑

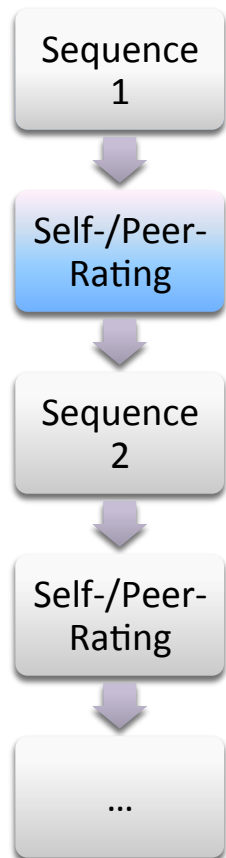
Hinweis: Die Skala erstreckt sich von 1=sehr gering ausgeprägt bis 6=sehr stark ausgeprägt.

Submit

12:58



# GAP Software (2) Observer



GAP - Observer Application

12:52:11 - asfasd asdfas: Schlägt Strategie vor  
12:54:56 - BERNHARD WELSER: Lenkt ein  
12:55:00 - sadfasd fas: Schlägt Prioritäten vor

**BERNHARD WELSER**  
Flugbegleiter 1

Pts: 1  
Err: 3  
MT: 0,56  
WT: 73h 15min  
Talk-Time: 00:00

+ Übernimmt Leitfunktion

+ Fasst zusammen

+ Schlägt Strategie vor

+ Verdeutlicht Konsequenzen

- Willigt zu schnell ein

- Stört

Rück

E

Ko

Bie

Global task screen

Flugbegleiter 1 - BERNHARD WELSER

|                   | FB 1  | FB 2  | FB 3  | FB 4   |
|-------------------|-------|-------|-------|--------|
| Montag 24.12.     |       |       |       |        |
| Dienstag 25.12.   |       |       | LH 51 |        |
| Mittwoch 26.12.   |       | LH 37 |       | LH 565 |
| Donnerstag 27.12. |       |       |       |        |
| Freitag 28.12.    | LH 35 |       |       |        |
| Samstag 29.12.    |       |       |       |        |
| Sonntag 30.12.    | LH 33 |       |       |        |
| Montag 31.12.     |       |       |       |        |
| Dienstag 01.01.   |       |       |       |        |

LH 561

LH 567

LH 569

LH 571

LH 573

LH 671

Flugbegleiter 2 - asfasd asdfas

|                   | FB 1  | FB 2  | FB 3  | FB 4   |
|-------------------|-------|-------|-------|--------|
| Montag 24.12.     |       |       |       | LH 561 |
| Dienstag 25.12.   |       |       | LH 51 |        |
| Mittwoch 26.12.   |       | LH 37 |       | LH 565 |
| Donnerstag 27.12. |       |       |       | LH 567 |
| Freitag 28.12.    | LH 35 |       |       |        |
| Samstag 29.12.    |       |       |       |        |
| Sonntag 30.12.    | LH 33 |       |       |        |
| Montag 31.12.     |       |       |       |        |
| Dienstag 01.01.   |       |       |       |        |

LH 569

LH 571

LH 573

LH 671

Flugbegleiter 3 - sadffa asdfas

|                   | FB 1  | FB 2  | FB 3  | FB 4   |
|-------------------|-------|-------|-------|--------|
| Montag 24.12.     |       |       |       | LH 561 |
| Dienstag 25.12.   |       |       | LH 51 |        |
| Mittwoch 26.12.   |       | LH 37 |       | LH 565 |
| Donnerstag 27.12. |       |       |       | LH 567 |
| Freitag 28.12.    | LH 35 |       |       |        |
| Samstag 29.12.    |       |       |       |        |
| Sonntag 30.12.    | LH 33 |       |       |        |
| Montag 31.12.     |       |       |       |        |
| Dienstag 01.01.   |       |       |       |        |

LH 569

LH 571

LH 573

LH 671

Flugbegleiter 4 - sadfasd fas

|                   | FB 1  | FB 2  | FB 3  | FB 4   |
|-------------------|-------|-------|-------|--------|
| Montag 24.12.     |       |       |       |        |
| Dienstag 25.12.   |       |       | LH 51 |        |
| Mittwoch 26.12.   |       | LH 37 |       | LH 565 |
| Donnerstag 27.12. |       |       |       | LH 567 |
| Freitag 28.12.    | LH 35 |       |       |        |
| Samstag 29.12.    |       |       |       |        |
| Sonntag 30.12.    | LH 33 |       |       |        |
| Montag 31.12.     |       |       |       |        |
| Dienstag 01.01.   |       |       |       |        |

LH 561

LH 569

LH 571

LH 573

LH 671

Observer 1

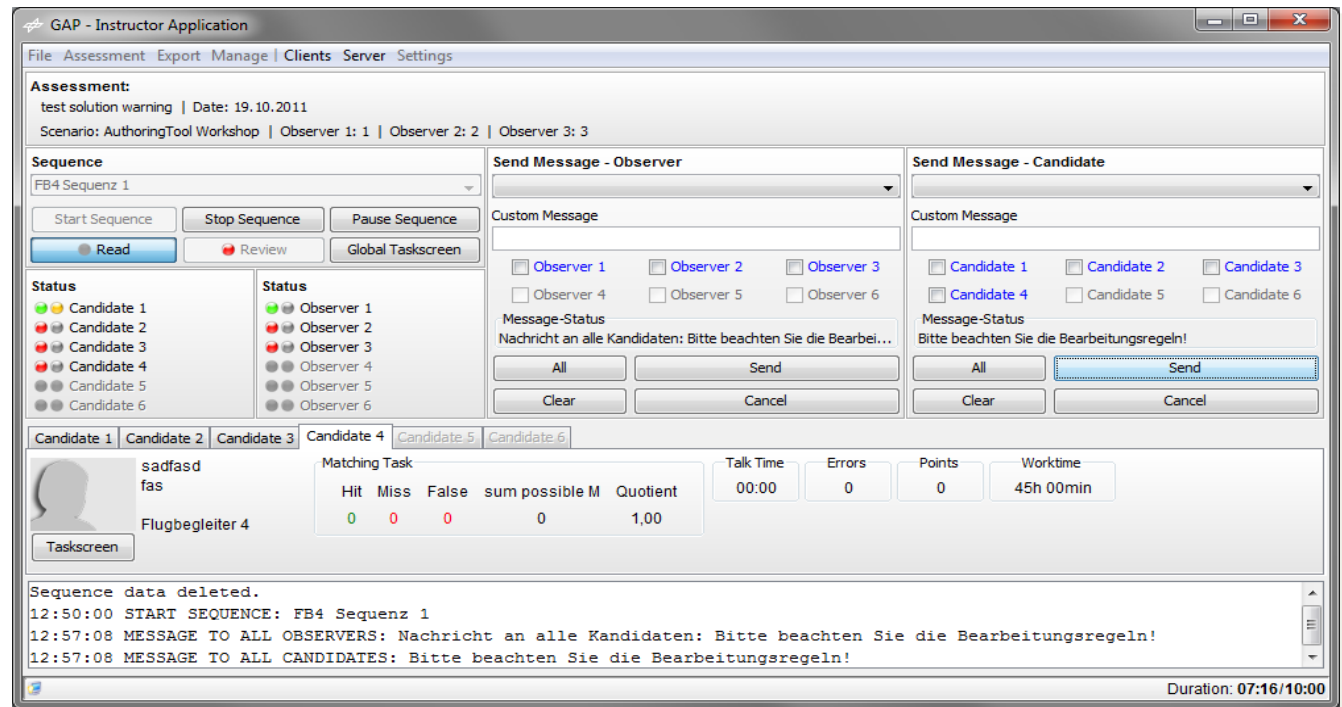
FB4 Sequenz 1 05:06/10:00



## GAP Software (3)

### Test Leader

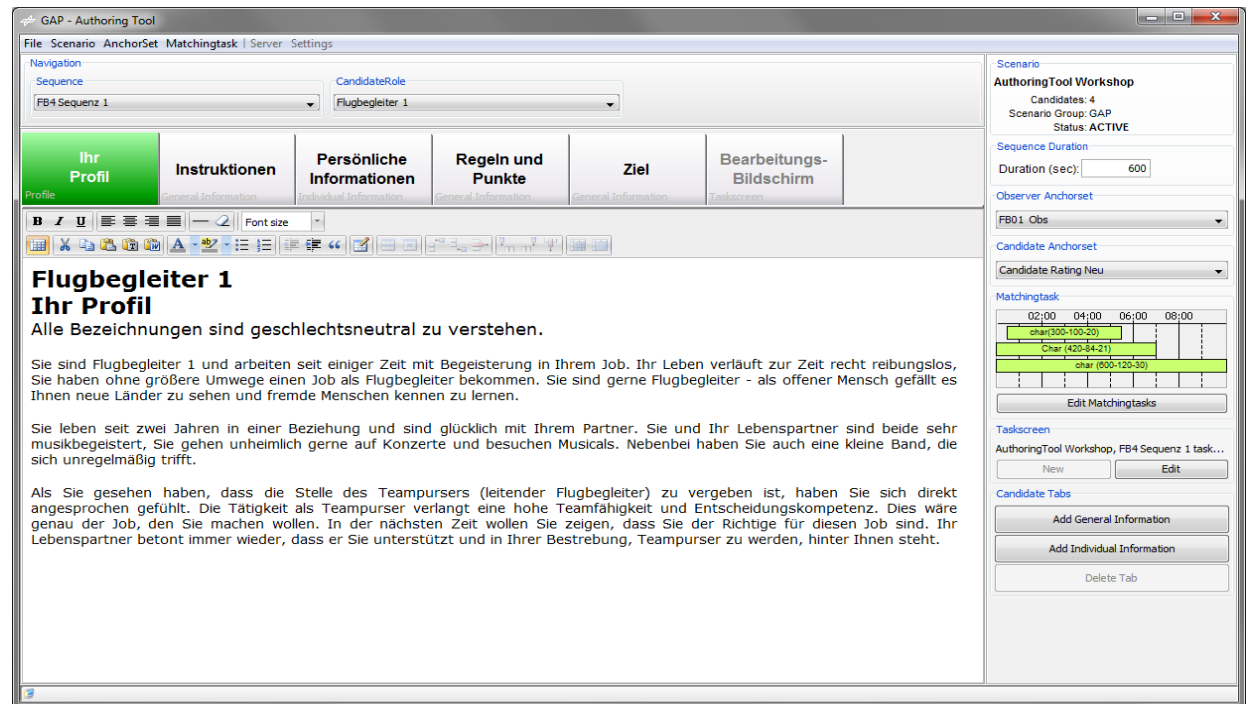
- Steering and monitoring of tests
- Exporting results for evaluation and scientific analysis





# GAP Software (4) Authoring Tool

- Szenario editor
- Task screen editor
- Anchorset editor
- Matching task Editor



# Software Engineering Group



Knowledge for Tomorrow



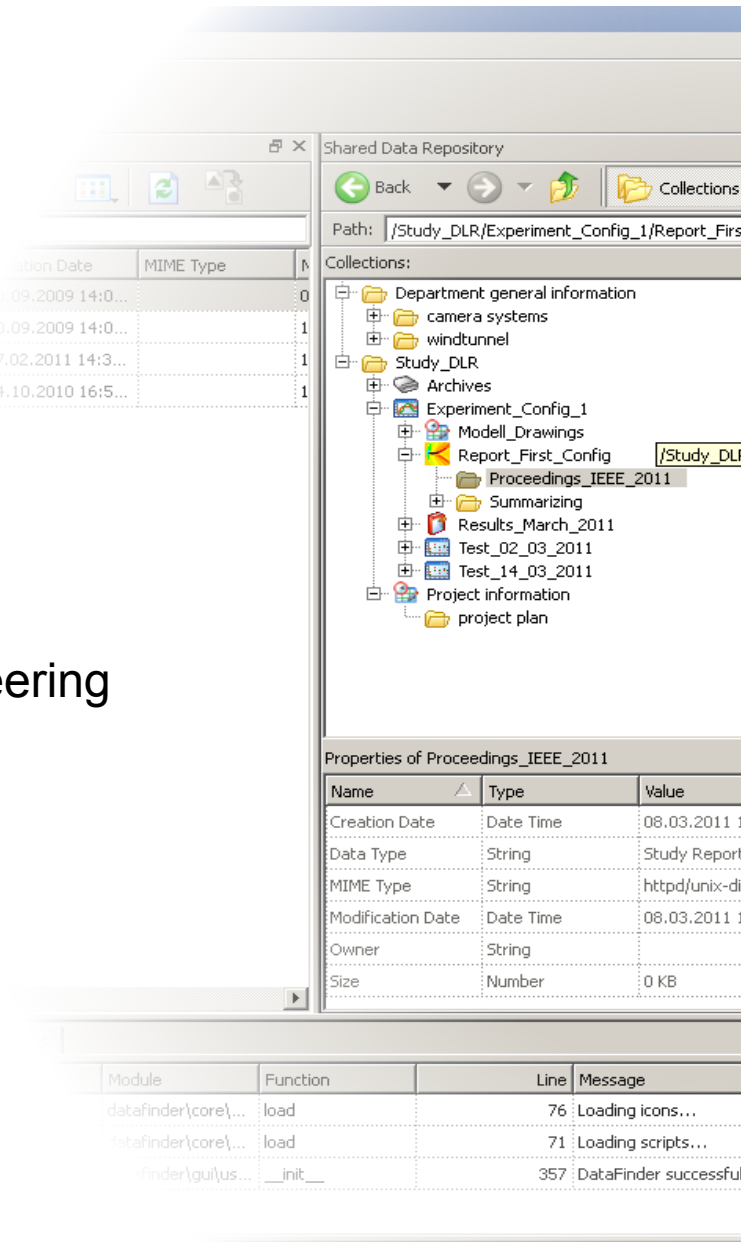
# Group Software Engineering Data Management

## Data and Knowledge Management

- Management of (huge) data sets
- Searching and finding data
- Long-term archiving
- Knowledge management for software engineering

## Tools for Studies and Experiments

- Planning studies (e.g., clinical trials)
- Electronic laboratory notebooks
- Data analysis (“Big Data”)

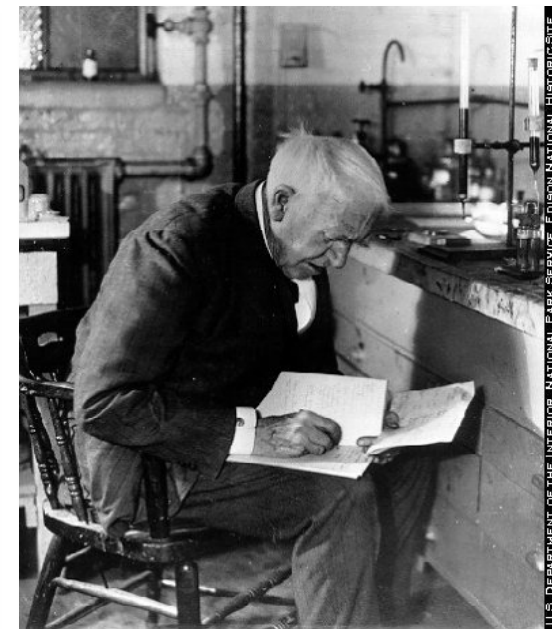
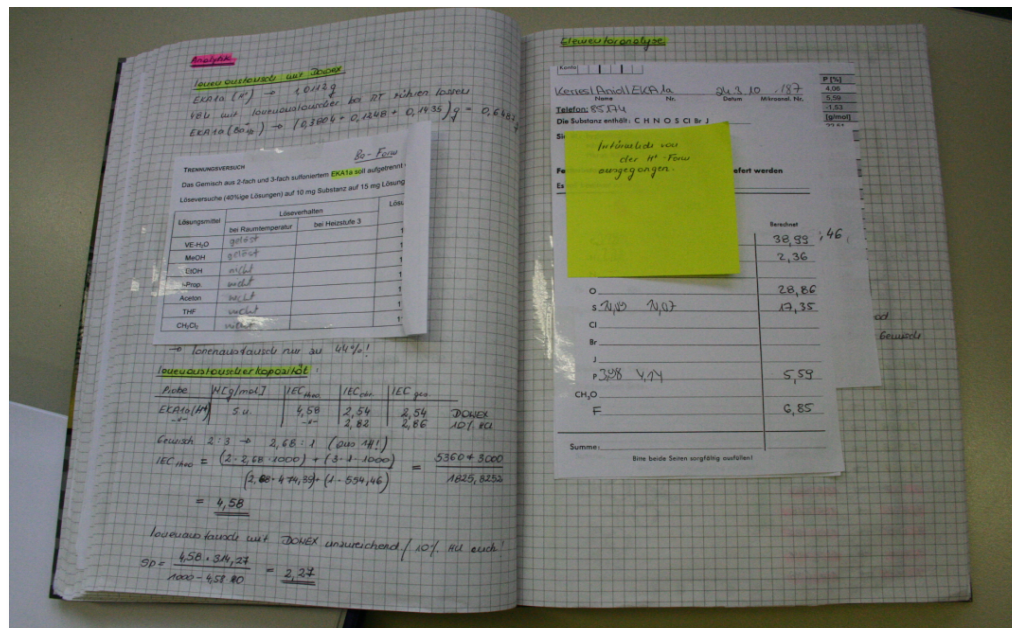




# Example Electronic Laboratory Notebooks

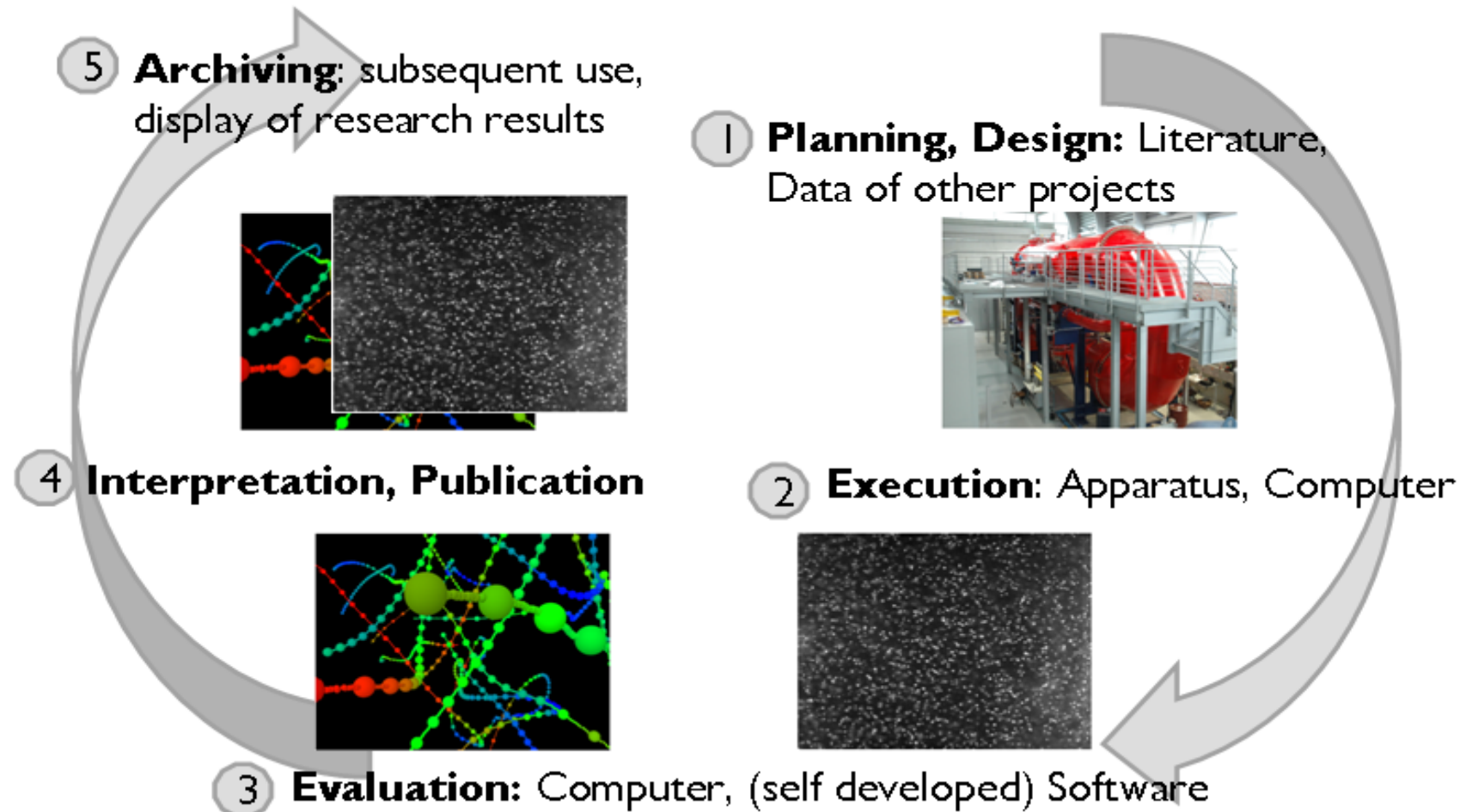
***“The laboratory notebook is the diary of  
the experimenting scientist”***

(Schreiben und Publizieren in den Naturwissenschaften  
Von Hans F. Ebel, Claus Bliefert, Walter Greulich; chapter 1.3 - page 16)





## Scientific Workflow



*Picture adapted from: [www.belab-forschung.de](http://www.belab-forschung.de)*



# Electronic Laboratory Notebook

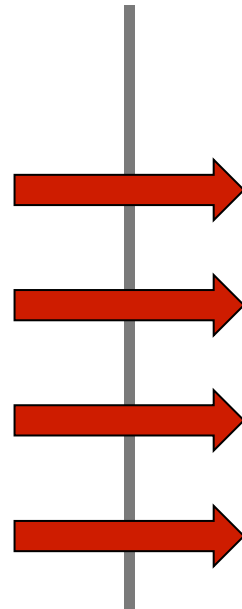
## Requirements for Good Scientific Documentation

### Requirements:

- Data structure
- Traceability
- Durability
- Credibility

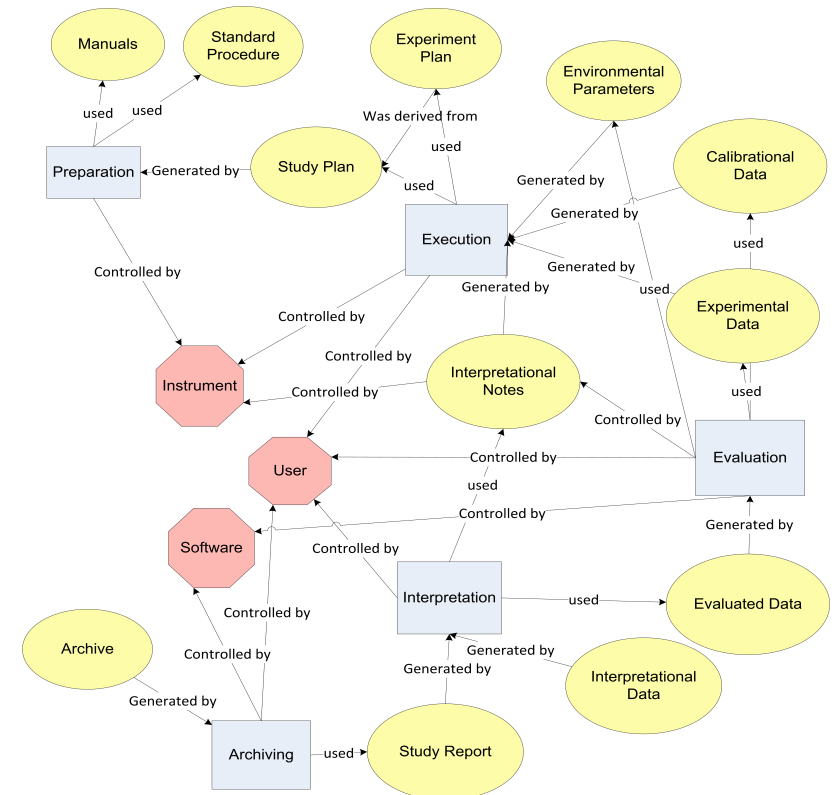
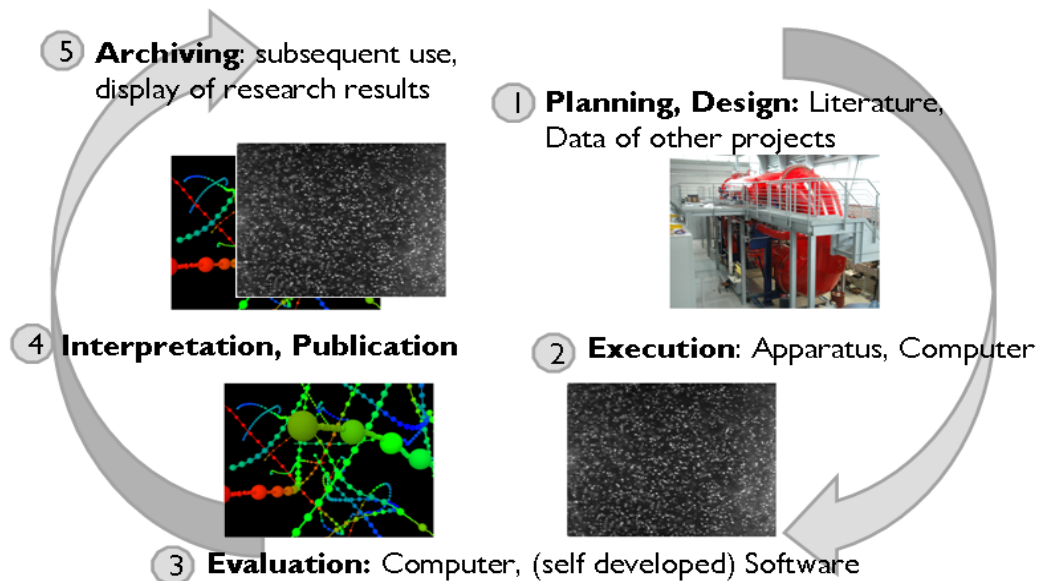
### Realization:

- Data model
- Process documentation
- Evidential preservation
- Signing data



# Process Documentation Provenance Data Model

- Apply methodology to define a Provenance model
- Representation of the real world's process



# Evidential Preservation

## Create an Archive With All Relevant Data

- User chooses report (publication etc.)
- Python script queries relevant files from the Provenance store
- Relevant files are added to an archive
- Validation via preservation service

The screenshot shows the 'Shared Data Repository' interface. The path is set to '/Study\_DLR/Experiment\_Config\_1/Report\_First\_Config/Proceedings\_IEEE\_2011'. The 'Collections' pane on the left shows a tree structure with folders like 'Department general information', 'Study\_DLR', 'Archives', 'Experiment\_Config\_1', 'Preparation', 'Report\_First\_Config', 'Proceedings\_IEEE\_2011', 'Summarizing', 'Results\_March\_2011', 'Video\_best', 'Test\_02\_03\_2011', 'windtunnel\_pressur', 'Test\_14\_03\_2011', and 'Project information'. The main pane displays a list of files including 'FirstReview...', 'presentation...', 'final\_paper...', 'test\_1\_.txt', 'final\_paper', 'abstr', and 'test\_'. A context menu is open over the 'final\_paper' file, showing options like 'Open', 'Use Script', 'Commit Archive', 'Search...', 'Cut', 'Copy', 'Copy Properties', 'Paste', 'Delete', 'Rename', 'Select All', 'Reverse Selection', and 'Properties...'. A tooltip for the 'Use Script' option indicates it starts a script extension 'Create Archive for BeLab Service' and lists data formats (PDF, TEXT) and types (File). Below the main pane, the 'Properties of final\_paper.pdf' are shown in a table.

| Name                | Type      | Value        |
|---------------------|-----------|--------------|
| Content Creation... | Date Time | 18.04.2011   |
| Content Modifica... | Date Time | 18.04.2011   |
| Content Size        | Number    | 0 KB         |
| Creation Date       | Date Time | 18.04.2011   |
| Data Format         | String    | PDF          |
| MIME Type           | String    | application, |
| Modification Date   | Date Time | 18.04.2011   |





# Signing Data

## Scientists sign the data

### Signature of the data (files) as separate file

- User chooses a file and executes script
- A signature file is generated (PKCS #7)
- Signature file is stored in the DataFinder

The screenshot displays a software interface with a file explorer on the left and a properties window on the right. The file explorer shows a tree structure with folders like 'Archives', 'Experiment\_Config\_1', 'Preparation', 'Plan', 'windtunnel', 'Report\_First\_Config', 'Proceedings\_IEEE\_2', 'Summarizing', 'Results\_March\_2011', and 'Video\_best'. The 'Video\_best' folder is selected, and a file named 'minuteOne.txt' is highlighted. The properties window for 'minuteOne.txt' shows the following details:

| Name                | Type      | Value               |
|---------------------|-----------|---------------------|
| Content Creation... | Date Time | 08.02.2011 19:14:04 |
| Content Modifica... | Date Time | 08.02.2011 19:14:20 |
| Content Size        | Number    | 0 KB                |
| Creation Date       | Date Time | 16.04.2011 15:58:00 |
| Data Format         | String    | TEXT                |
| MIME Type           | String    | text/plain          |
| Modification Date   | Date Time | 16.04.2011 15:58:09 |
| Owner               | String    |                     |

At the bottom of the interface, there is a log window with the following entries:

| Level | Created           | Logger       | Module               | Function         | Line | Message                       |
|-------|-------------------|--------------|----------------------|------------------|------|-------------------------------|
| INFO  | 18.04.11 09:08:30 | root         | datafinder.core.c... | load             | 102  | Loading icons...              |
| INFO  | 18.04.11 09:08:30 | root         | datafinder.core.c... | load             | 97   | Loading scripts...            |
| INFO  | 18.04.11 09:08:24 | webdavLogger | lib.site-packages... | _blockCopySocket | 227  | Transferred 1415 bytes.       |
| INFO  | 18.04.11 09:08:24 | script       | signdata.sign_da...  | handleSigning    | 98   | signature successfully stored |

1 items selected.



## Example Medical Studies



| study day     | BDC -4                           |                                  | BDC -5                         |                     | Breath Test:<br>Im 1h Takt     | BDC -6                         |  | Breath Test:<br>Im 1h Takt | BDC -7               |          | Breath Test:<br>Im 1h Takt |         |   | study day     |
|---------------|----------------------------------|----------------------------------|--------------------------------|---------------------|--------------------------------|--------------------------------|--|----------------------------|----------------------|----------|----------------------------|---------|---|---------------|
| wake-up order | 3                                | 4                                | 7                              | 8                   |                                | 1                              | 2                                      |                            | 5                    | 6        |                            |         |   | wake-up order |
| subject       | A                                | B                                | C                              | D                   |                                | E                              | F                                      |                            | G                    | H        |                            | K       | L | subject       |
| 6:30          | Temp, BP                         | Temp, BP                         | Temp, BP                       | Temp, BP            | Temp, BP                       | Temp, BP                       | Temp, BP                               | Temp, BP                   | Temp, BP             | Temp, BP |                            |         |   | 6:30          |
| 6:45          |                                  |                                  | BD 1B (05)                     | BD 1B (05)          | BD 1A (05)                     | BD 1A (05)                     | BD 1A (05)                             | BD 1(Saf. BCD 05,21)       | BD 1(Saf. BCD 05,21) |          |                            |         |   | 6:45          |
| 7:00          | Braunle                          | Braunle                          |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 7:00          |
| 7:15          | Urine 3 (05.NEG),BW              | Urine 3 (05.NEG),BW              | Urine 2 (05.NEG),BW            | Urine 2 (05.NEG),BW | Ur 1(05,21.NEG),BW             | Ur 1(05,21.NEG),BW             | Urine 0 (Safety), BW                   | Urine 0 (Safety), BW       |                      |          |                            |         |   | 7:15          |
| 7:30          |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 7:30          |
| 7:45          |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 7:45          |
| 8:00          |                                  |                                  | Breakfast                      | Breakfast           | DEXA                           | DEXA                           | RMR<br>(Dietcalc.) AMSAN               |                            |                      |          |                            |         |   | 8:00          |
| 8:15          | Lipid test                       | Lipid test                       |                                |                     | Elisabeth-<br>Hospital Cologne | Elisabeth-<br>Hospital Cologne | Breakfast                              | RMR<br>(Dietcalc.) AMSAN   |                      |          |                            |         |   | 8:15          |
| 8:30          |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 8:30          |
| 8:45          | PhL<br>BD 4-14                   | PhL<br>BD 4-14                   | Sensory weighting              | Sensory weighting   | Drink to go                    | Drink to go                    | Eyeexamination II                      | Breakfast                  |                      |          |                            |         |   | 8:45          |
| 9:00          |                                  |                                  | AMSAN                          | AMSAN               |                                |                                | AMC                                    |                            |                      |          |                            |         |   | 9:00          |
| 9:15          |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 9:15          |
| 9:30          | High fat meal                    | High fat meal                    |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 9:30          |
| 9:45          |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 9:45          |
| 10:00         |                                  |                                  | Sensory weighting              |                     | Breakfast                      | Breakfast                      | MVC,<br>muscle fatigue<br>(Fam)<br>PhL | Eyeexamination II          |                      |          |                            |         |   | 10:00         |
| 10:15         |                                  |                                  | AMSAN                          | Sensory weighting   |                                |                                |  | AMC                        |                      |          |                            |         |   | 10:15         |
| 10:30         |                                  |                                  |                                | AMSAN               |                                |                                |  |                            |                      |          |                            |         |   | 10:30         |
| 10:45         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 10:45         |
| 11:00         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 11:00         |
| 11:15         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 11:15         |
| 11:30         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 11:30         |
| 11:45         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 11:45         |
| 12:00         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 12:00         |
| 12:15         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 12:15         |
| 12:30         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 12:30         |
| 12:45         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 12:45         |
| 13:00         |                                  |                                  | Lunch                          | Lunch               | Lunch                          |                                |  |                            |                      |          |                            |         |   | 13:00         |
| 13:15         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 13:15         |
| 13:30         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 13:30         |
| 13:45         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 13:45         |
| 14:00         |                                  |                                  | Plasma volume<br>PhL<br>BD 2+3 |                     | Achilles tendon US<br>AMSAN    |                                |  | Eyeexamination I           |                      |          |                            |         |   | 14:00         |
| 14:15         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 14:15         |
| 14:30         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 14:30         |
| 14:45         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 14:45         |
| 15:00         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 15:00         |
| 15:15         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 15:15         |
| 15:30         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 15:30         |
| 15:45         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 15:45         |
| 16:00         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 16:00         |
| 16:15         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 16:15         |
| 16:30         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 16:30         |
| 16:45         | extended Snack                   |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 16:45         |
| 17:00         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 17:00         |
| 17:15         | Muscle+Fat biopsy<br>(right leg) | extended Snack                   |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 17:15         |
| 17:30         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 17:30         |
| 17:45         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 17:45         |
| 18:00         | PhL                              |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 18:00         |
| 18:15         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 18:15         |
| 18:30         |                                  | Muscle+Fat biopsy<br>(right leg) |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 18:30         |
| 18:45         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 18:45         |
| 19:00         | Dinner                           | PhL                              | Dinner                         | Dinner              | Dinner                         | Dinner                         | Dinner                                 | Dinner                     | Dinner               | Dinner   |                            |         |   | 19:00         |
| 19:15         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 19:15         |
| 19:30         | LOG                              |                                  | LOG                            | LOG                 | LOG                            | LOG                            | LOG                                    | LOG                        | LOG                  | LOG      |                            |         |   | 19:30         |
| 19:45         |                                  | Dinner                           |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 19:45         |
| 20:00         |                                  | LOG                              |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 20:00         |
| 20:15         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 20:15         |
| 20:30         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 20:30         |
| 20:45         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 20:45         |
| 21:00         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 21:00         |
| 21:15         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 21:15         |
| 21:30         | Snack                            | Snack                            | Snack                          | Snack               | Snack                          | Snack                          | Snack                                  | Snack                      | Snack                | Snack    | Drink                      | Drink   |   | 21:30         |
| 21:45         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 21:45         |
| 22:00         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 22:00         |
| 22:15         | Bedtime                          | Bedtime                          | Bedtime                        | Bedtime             | Bedtime                        | Bedtime                        | Bedtime                                | Bedtime                    | Bedtime              | Bedtime  | Bedtime                    | Bedtime |   | 22:15         |
| 22:30         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 22:30         |
| 22:45         |                                  |                                  |                                |                     |                                |                                |  |                            |                      |          |                            |         |   | 22:45         |





| study day | BDC -3                         |                                | BDC -4              |                               | BDC -5              |                     | Breath Test:<br>Im 1h Takt | BDC -6                     |                            | Breath Test:<br>Im 1h Takt | BDC -7                        |                       | Breath Test:<br>Im 1h Takt | study day |
|-----------|--------------------------------|--------------------------------|---------------------|-------------------------------|---------------------|---------------------|----------------------------|----------------------------|----------------------------|----------------------------|-------------------------------|-----------------------|----------------------------|-----------|
| subject   | A                              | B                              | C                   | D                             | E                   | F                   |                            | G                          | H                          |                            | K                             | L                     |                            | subject   |
| 6:30      | Temp, BP                       | Temp, BP                       | Temp, BP            | Temp, BP                      | Temp, BP            | Temp, BP            | Temp, BP                   | Temp, BP                   | Temp, BP                   | Temp, BP                   | Temp, BP                      | Temp, BP              | Temp, BP                   | 6:30      |
| 6:45      |                                |                                |                     |                               | BD 1B (05)          | BD 1B (05)          | BD 1A (05)                 | BD 1A (05)                 | BD 1A (05)                 | BD 1A (05)                 | BD 1(Saf., BCD,05,21)         | BD 1(Saf., BCD,05,21) | BD 1(Saf., BCD,05,21)      | 6:45      |
| 7:00      |                                |                                | Braunole            | Braunole                      | Urine 2 (05.NEG),BW | Urine 2 (05.NEG),BW | Ur 1(05,21.NEG),BW         | Ur 1(05,21.NEG),BW         | Ur 1(05,21.NEG),BW         | Ur 1(05,21.NEG),BW         | Urine 0 (Safety), BW          | Urine 0 (Safety), BW  | Urine 0 (Safety), BW       | 7:00      |
| 7:15      | Urine 4 (05.NEG),BW            | Urine 4 (05.NEG),BW            | Urine 3 (05.NEG),BW | Urine 3 (05.NEG),BW           |                     |                     |                            |                            |                            |                            | RMR                           | RMR                   | RMR                        | 7:15      |
| 7:30      |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            | (Dietcalc.) AMSAN             | (Dietcalc.) AMSAN     | (Dietcalc.) AMSAN          | 7:30      |
| 7:45      |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            | Breakfast                     | Breakfast             | Breakfast                  | 7:45      |
| 8:00      | Breakfast                      | Breakfast                      |                     |                               | Breakfast           | Breakfast           | DEXA                       | DEXA                       | DEXA                       | DEXA                       |                               |                       |                            | 8:00      |
| 8:15      |                                |                                | Lipid test          | Lipid test                    |                     |                     | Elisabeth-Hospital Cologne | Elisabeth-Hospital Cologne | Elisabeth-Hospital Cologne | Elisabeth-Hospital Cologne |                               |                       |                            | 8:15      |
| 8:30      |                                |                                | PhL                 | PhL                           | Sensory weighting   | Sensory weighting   |                            |                            |                            |                            |                               |                       |                            | 8:30      |
| 8:45      |                                |                                | BD 4-14             | BD 4-14                       | AMSAN               | AMSAN               | Drink to go                | Drink to go                | Drink to go                | Drink to go                | Eyeexamination II             | Breakfast             | Breakfast                  | 8:45      |
| 9:00      |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            | AMC                           |                       |                            | 9:00      |
| 9:15      |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 9:15      |
| 9:30      |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 9:30      |
| 9:45      |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 9:45      |
| 10:00     |                                |                                | High fat meal       | High fat meal                 |                     |                     |                            |                            |                            |                            |                               |                       |                            | 10:00     |
| 10:15     |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 10:15     |
| 10:30     |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 10:30     |
| 10:45     |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 10:45     |
| 11:00     |                                |                                |                     |                               | Sensory weighting   | Sensory weighting   | Breakfast                  | Breakfast                  | Breakfast                  | Breakfast                  | MVC, muscle fatigue (Fam) PhL | Eyeexamination II     | Eyeexamination II          | 11:00     |
| 11:15     |                                |                                |                     |                               | AMSAN               | AMSAN               |                            |                            |                            |                            |                               | AMC                   | AMC                        | 11:15     |
| 11:30     |                                |                                |                     |                               |                     |                     | pQCT                       |                            |                            |                            |                               |                       |                            | 11:30     |
| 11:45     |                                |                                |                     |                               |                     |                     | Celler room B62            |                            |                            |                            |                               |                       |                            | 11:45     |
| 12:00     |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 12:00     |
| 12:15     |                                |                                |                     |                               | PG, DGI AMSAN       |                     |                            |                            | pQCT                       |                            |                               |                       |                            | 12:15     |
| 12:30     |                                |                                |                     |                               |                     |                     |                            |                            | Celler room B62            |                            |                               |                       |                            | 12:30     |
| 12:45     |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 12:45     |
| 13:00     | Lunch                          | Lunch                          |                     |                               | Lunch               | Lunch               | Lunch                      | Lunch                      | Lunch                      | Lunch                      | Lunch                         | Lunch                 | Lunch                      | 13:00     |
| 13:15     |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 13:15     |
| 13:30     |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 13:30     |
| 13:45     | BW (AMSAN)                     |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 13:45     |
| 14:00     |                                |                                |                     |                               | Plasma volume PhL   | PG, DGI AMSAN       | Achilles tendon US AMSAN   |                            |                            |                            |                               |                       |                            | 14:00     |
| 14:15     | MVC, muscle fatigue (left leg) |                                |                     |                               | BD 2+3              |                     |                            |                            |                            |                            |                               |                       |                            | 14:15     |
| 14:30     |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 14:30     |
| 14:45     | PhL                            |                                |                     |                               |                     | Plasma volume PhL   | Muscle fatigue             |                            |                            |                            |                               |                       |                            | 14:45     |
| 15:00     |                                |                                |                     |                               |                     | BD 2+3              | NMR-lab                    |                            |                            |                            |                               |                       |                            | 15:00     |
| 15:15     |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 15:15     |
| 15:30     |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 15:30     |
| 15:45     |                                | BW (AMSAN)                     |                     | extended Snack                |                     |                     |                            |                            |                            |                            |                               |                       |                            | 15:45     |
| 16:00     | BW (AMSAN)                     |                                | extended Snack      |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 16:00     |
| 16:15     |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 16:15     |
| 16:30     |                                | MVC, muscle fatigue (left leg) |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 16:30     |
| 16:45     |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 16:45     |
| 17:00     |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 17:00     |
| 17:15     |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 17:15     |
| 17:30     |                                | PhL                            |                     | Muscle+Fat biopsy (right leg) |                     |                     |                            |                            |                            |                            |                               |                       |                            | 17:30     |
| 17:45     |                                |                                |                     | PhL                           |                     |                     |                            |                            |                            |                            |                               |                       |                            | 17:45     |
| 18:00     |                                | BW (AMSAN)                     |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 18:00     |
| 18:15     |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 18:15     |
| 18:30     |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 18:30     |
| 18:45     |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 18:45     |
| 19:00     | Dinner                         | Dinner                         |                     |                               | Dinner              | Dinner              | Dinner                     | Dinner                     | Dinner                     | Dinner                     | Dinner                        | Dinner                | Dinner                     | 19:00     |
| 19:15     |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 19:15     |
| 19:30     | LOG                            | LOG                            |                     |                               | LOG                 | LOG                 | LOG                        | LOG                        | LOG                        | LOG                        | LOG                           | LOG                   | LOG                        | 19:30     |
| 19:45     |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 19:45     |
| 20:00     |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 20:00     |
| 20:15     |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 20:15     |
| 20:30     |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 20:30     |
| 20:45     |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 20:45     |
| 21:00     |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 21:00     |
| 21:15     |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 21:15     |
| 21:30     | Snack                          | Snack                          |                     |                               | Snack               | Snack               | Snack                      | Snack                      | Snack                      | Snack                      | Snack                         | Snack                 | Snack                      | 21:30     |
| 21:45     |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 21:45     |
| 22:00     |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 22:00     |
| 22:15     |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 22:15     |
| 22:30     | Bedtime                        | Bedtime                        |                     |                               | Bedtime             | Bedtime             | Bedtime                    | Bedtime                    | Bedtime                    | Bedtime                    | Bedtime                       | Bedtime               | Bedtime                    | 22:30     |
| 22:45     |                                |                                |                     |                               |                     |                     |                            |                            |                            |                            |                               |                       |                            | 22:45     |

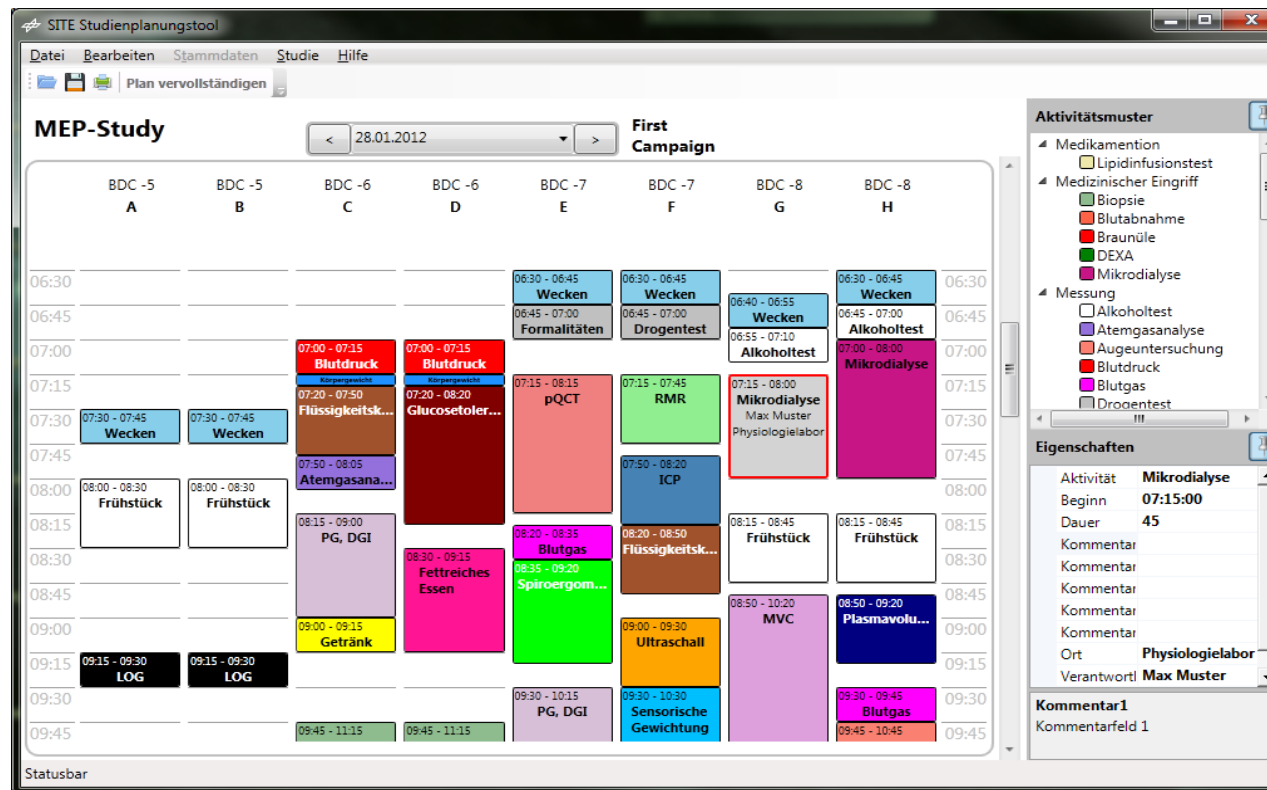




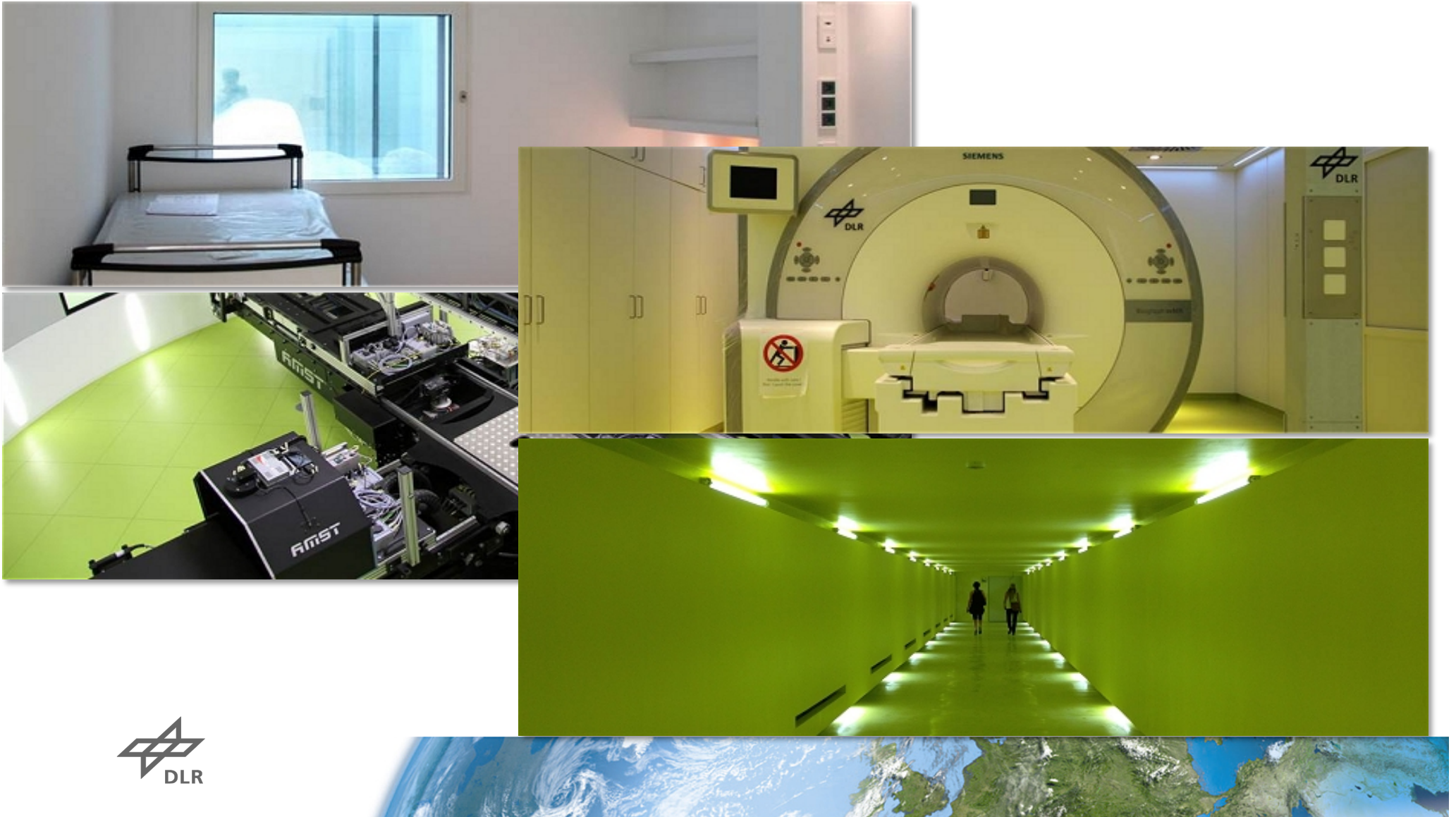
| study day     | R+1                  |                       | R+0                            |                                | HDT 21                    |                           | HDT 20               |                      | HDT 19                        |                               | study day     |
|---------------|----------------------|-----------------------|--------------------------------|--------------------------------|---------------------------|---------------------------|----------------------|----------------------|-------------------------------|-------------------------------|---------------|
| wake-up order | 7                    | 8                     | 3                              | 4                              | 5                         | 6                         | G                    | H                    | K                             | L                             | wake-up order |
| subject       | A                    | B                     | C                              | D                              | E                         | F                         |                      |                      |                               |                               | subject       |
| 6:30          | Breathtest           | Breathtest            | Temp, BP                       | Temp, BP                       | Breathtest                | Breathtest                | Temp, BP             | Temp, BP             | Temp, BP                      | Temp, BP                      | 6:30          |
| 6:45          | Temp, BP             | Temp, BP              |                                |                                | Temp, BP                  | Temp, BP                  |                      |                      |                               |                               | 6:45          |
| 7:00          | BD 53 (03.21.27.45)  | BD 53 (03.21.27.45)   | Braunüle                       | Braunüle                       | B42(BCD.03.14.21.27.45)   | B42(BCD.03.14.21.27.45)   |                      |                      | Braunüle                      | Braunüle                      | 7:00          |
| 7:15          | Urine 29 (05.21), BW | Urine 29 (05.21), BW  | U 28 (05.21.45,BCD),BW         | U 28 (05.21.45,BCD),BW         | Urine 27 (05.21.45),BW    | Urine 27 (05.21.45),BW    | Urine 26 (05.45), BW | Urine 26 (05.45), BW | Urine 25 (05), BW             | Urine 25 (05), BW             | 7:15          |
| 7:30          | BGA                  | BGA                   | Breakfast                      | Breakfast                      | BGA                       | BGA                       | Breakfast            | Breakfast            |                               |                               | 7:30          |
| 7:45          |                      |                       | 24h ECG-stop+start             | 24h ECG-stop+start             | 24h ECG-start             | 24h ECG-start             | + WP/KHCO3           |                      |                               |                               | 7:45          |
| 8:00          | Breakfast            | Breakfast             |                                | Breakfast                      |                           |                           | Sensory weighting    | Breakfast            | Lipid test                    | Lipid test                    | 8:00          |
| 8:15          |                      |                       |                                |                                | Microdialysis (right leg) | Microdialysis (right leg) | AMSAN                | Sensory weighting    | PhL                           | PhL                           | 8:15          |
| 8:30          | Muscle fatigue       |                       |                                |                                | PhL                       | PhL                       |                      | AMSAN                | BD 31-41                      | BD 32-42                      | 8:30          |
| 8:45          | NMR-lab              |                       |                                |                                |                           |                           |                      |                      |                               |                               | 8:45          |
| 9:00          |                      |                       | Tilt Table+LBNP                |                                |                           |                           |                      |                      |                               |                               | 9:00          |
| 9:15          |                      |                       | End of HDT                     |                                |                           |                           |                      |                      |                               |                               | 9:15          |
| 9:30          |                      |                       | PhL                            |                                |                           |                           |                      |                      |                               |                               | 9:30          |
| 9:45          |                      |                       | BD 50-52                       |                                |                           |                           |                      |                      |                               |                               | 9:45          |
| 10:00         |                      | Muscle fatigue        |                                |                                | Glucose tolerance         | Glucose tolerance         | Snack                |                      | High fat meal                 | High fat meal                 | 10:00         |
| 10:15         |                      |                       |                                |                                |                           |                           | +WP/KHCO3            |                      |                               |                               | 10:15         |
| 10:30         |                      | NMR-lab               |                                | Snack                          | PhL                       | PhL                       | Sensory weighting    | Snack                |                               |                               | 10:30         |
| 10:45         |                      |                       |                                |                                | BD 43-47                  | BD 43-47                  | AMSAN                | Sensory weighting    |                               |                               | 10:45         |
| 11:00         |                      |                       |                                |                                |                           |                           |                      |                      |                               |                               | 11:00         |
| 11:15         |                      |                       |                                |                                |                           |                           |                      |                      |                               |                               | 11:15         |
| 11:30         |                      |                       |                                |                                |                           |                           |                      |                      |                               |                               | 11:30         |
| 11:45         | Eyeexamination II    | END OF IMMOBILISATION | 24h ECG-stop                   | Tilt Table+LBNP                |                           |                           | Achilles tendon US   |                      |                               |                               | 11:45         |
| 12:00         | AMC                  |                       | Snack                          |                                |                           |                           | AMSAN                |                      |                               |                               | 12:00         |
| 12:15         |                      |                       | PG, DGI                        |                                |                           |                           |                      |                      |                               |                               | 12:15         |
| 12:30         |                      |                       | AMSAN                          |                                |                           |                           |                      |                      |                               |                               | 12:30         |
| 12:45         |                      |                       |                                | End of HDT                     |                           |                           |                      |                      |                               |                               | 12:45         |
| 13:00         | Lunch                | Lunch                 | Lunch                          | PhL                            | Lunch                     | Lunch                     | Lunch                | Lunch                |                               |                               | 13:00         |
| 13:15         |                      |                       |                                | BD 50-52                       | + WP/KHCO3 (x2)           |                           | + WP/KHCO3           |                      |                               |                               | 13:15         |
| 13:30         |                      |                       |                                |                                |                           |                           |                      |                      |                               |                               | 13:30         |
| 13:45         |                      |                       | Eyeexamination I               |                                | Plasma volume             | Plasma volume             |                      | Achilles tendon US   |                               |                               | 13:45         |
| 14:00         |                      |                       | AMC                            |                                | PhL                       | PhL                       |                      | AMSAN                |                               |                               | 14:00         |
| 14:15         |                      |                       |                                |                                | BD 48+49                  | BD 48+49                  | Shower               |                      |                               |                               | 14:15         |
| 14:30         |                      |                       |                                |                                |                           |                           |                      |                      |                               |                               | 14:30         |
| 14:45         |                      |                       |                                |                                |                           |                           |                      |                      |                               |                               | 14:45         |
| 15:00         |                      | Eyeexamination II     |                                | 24h ECG-stop                   | END OF IMMOBILISATION     |                           |                      |                      |                               |                               | 15:00         |
| 15:15         |                      |                       |                                | Lunch                          |                           |                           |                      |                      |                               |                               | 15:15         |
| 15:30         | VO2max               | AMC                   |                                |                                |                           |                           |                      |                      |                               |                               | 15:30         |
| 15:45         | PhL                  |                       | MVC, muscle fatigue (left leg) |                                | Snack                     | Snack                     |                      |                      | extended Snack                | extended Snack                | 15:45         |
| 16:00         |                      |                       |                                |                                | +WP/KHCO3                 |                           |                      |                      | + WP/KHCO3 (X2)               |                               | 16:00         |
| 16:15         |                      |                       |                                |                                |                           |                           |                      |                      |                               |                               | 16:15         |
| 16:30         |                      | VO2max                |                                |                                |                           |                           |                      |                      |                               |                               | 16:30         |
| 16:45         |                      | PhL                   |                                |                                |                           |                           |                      |                      |                               |                               | 16:45         |
| 17:00         |                      |                       |                                | Eyeexamination I               |                           |                           |                      |                      | Muscle+Fat biopsy (right leg) |                               | 17:00         |
| 17:15         |                      |                       |                                | AMC                            |                           |                           |                      |                      | PhL                           |                               | 17:15         |
| 17:30         |                      |                       | Shower                         |                                |                           |                           |                      | Snack                |                               |                               | 17:30         |
| 17:45         |                      |                       |                                |                                |                           |                           |                      |                      |                               |                               | 17:45         |
| 18:00         | 24h ECG-stop         |                       | 24h ECG-stop+start             |                                | pQCT                      |                           |                      |                      |                               |                               | 18:00         |
| 18:15         |                      |                       |                                |                                | Celler room B62           |                           |                      |                      |                               |                               | 18:15         |
| 18:30         |                      |                       |                                |                                |                           |                           |                      |                      |                               |                               | 18:30         |
| 18:45         |                      |                       |                                |                                |                           |                           |                      |                      |                               |                               | 18:45         |
| 19:00         | Dinner               | Dinner                | Dinner                         | MVC, muscle fatigue (left leg) | Dinner                    | pQCT                      |                      |                      | Dinner                        | Muscle+Fat biopsy (right leg) | 19:00         |
| 19:15         |                      |                       |                                |                                | + WP/KHCO3 (x2)           |                           |                      |                      | + WP/KHCO3 (x2)               |                               | 19:15         |
| 19:30         | LOG                  | LOG                   | LOG                            | PhL                            | LOG                       | Celler room B62           |                      |                      | LOG                           | PhL                           | 19:30         |
| 19:45         |                      |                       |                                |                                |                           |                           |                      |                      |                               |                               | 19:45         |
| 20:00         |                      |                       |                                |                                |                           |                           |                      |                      |                               |                               | 20:00         |
| 20:15         | ICP                  | ICP                   |                                | Dinner                         |                           |                           |                      |                      | Shower                        |                               | 20:15         |
| 20:30         |                      |                       |                                | LOG                            |                           |                           |                      |                      |                               |                               | 20:30         |
| 20:45         |                      |                       |                                | ICP                            | ICP                       |                           |                      |                      |                               |                               | 20:45         |
| 21:00         |                      |                       |                                | Shower                         |                           |                           |                      |                      | ICP                           | ICP                           | 21:00         |
| 21:15         |                      |                       |                                |                                |                           |                           |                      |                      |                               |                               | 21:15         |
| 21:30         | Drink                | Drink                 | Snack                          | 24h ECG-stop+start             | Snack                     | Snack                     |                      |                      | Snack                         | Snack                         | 21:30         |
| 21:45         |                      | 24h ECG-stop          |                                | Snack                          | +WP/KHCO3                 |                           |                      |                      | +WP/KHCO3 (x2)                |                               | 21:45         |
| 22:00         |                      |                       |                                |                                | Ass.of headache           | Ass.of headache           |                      |                      | Ass.of headache               | Ass.of headache               | 22:00         |
| 22:15         |                      |                       |                                |                                |                           |                           |                      |                      |                               |                               | 22:15         |
| 22:30         | Bedtime              | Bedtime               | Bedtime                        | Bedtime                        | Bedtime                   | Bedtime                   | Bedtime              | Bedtime              | Bedtime                       | Bedtime                       | 22:30         |
| 22:45         |                      |                       |                                |                                |                           |                           |                      |                      |                               |                               | 22:45         |



# Software System :study Managing Medical Studies

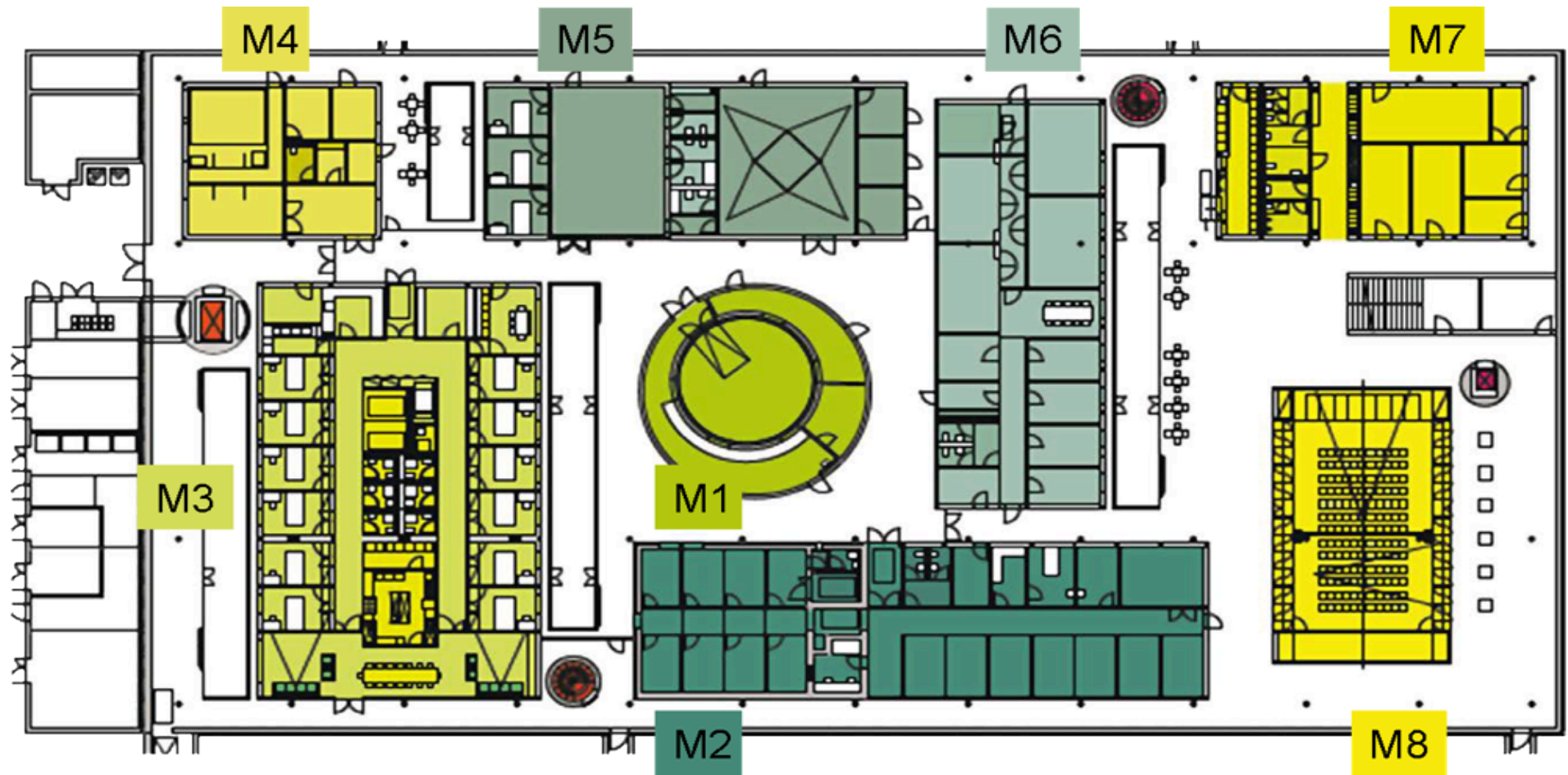


## Complex Environments





## DLR :envihab





# :studycompanion App

## App for patients and study participants

- Daily schedule
- Current location
- Directions (*In-door navigation*)



 :studycompanion



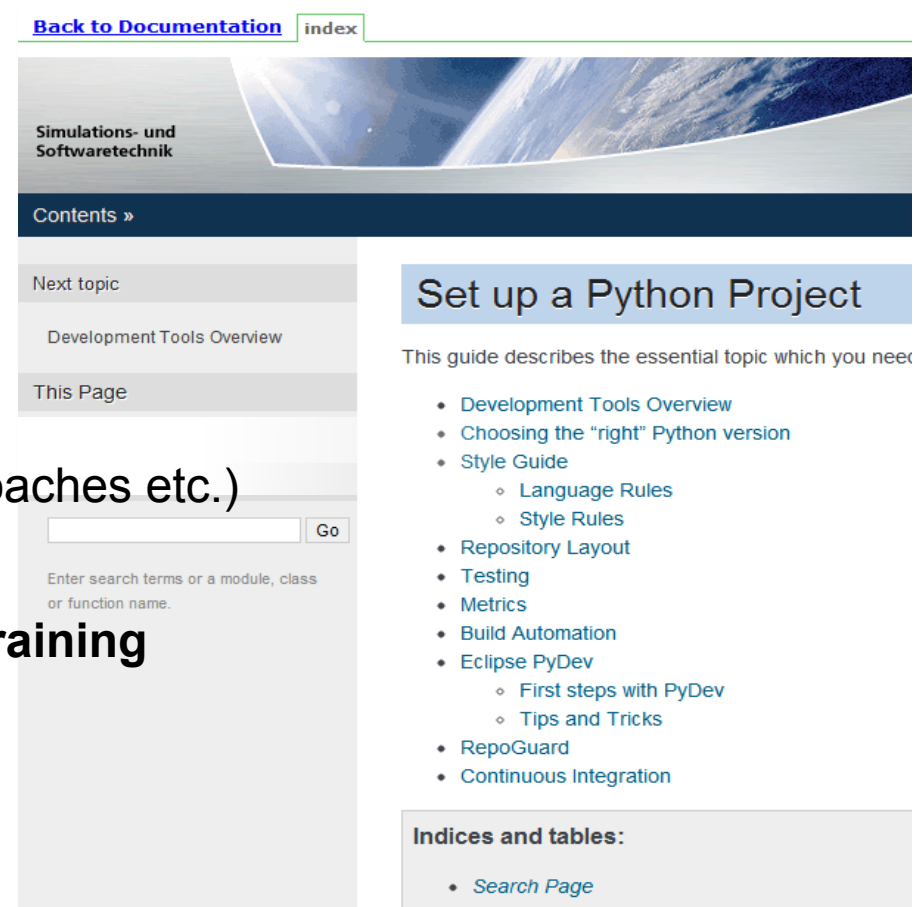
# Group Software Engineering Methods and Tools

## Research in Methods and Tools

- Automated Software Engineering
- Software configuration management
- Validation and verification
- Modern software architectures
- Development processes (agile approaches etc.)

## Software Engineering Consulting and Training

- Development tools
- Open Source Development



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Simulations- und Softwaretechnik

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Next topic

[Development Tools Overview](#)

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Enter search terms or a module, class or function name.

### Set up a Python Project

This guide describes the essential topic which you need

- [Development Tools Overview](#)
- [Choosing the "right" Python version](#)
- [Style Guide](#)
  - [Language Rules](#)
  - [Style Rules](#)
- [Repository Layout](#)
- [Testing](#)
- [Metrics](#)
- [Build Automation](#)
- [Eclipse PyDev](#)
  - [First steps with PyDev](#)
  - [Tips and Tricks](#)
- [RepoGuard](#)
- [Continuous Integration](#)

**Indices and tables:**

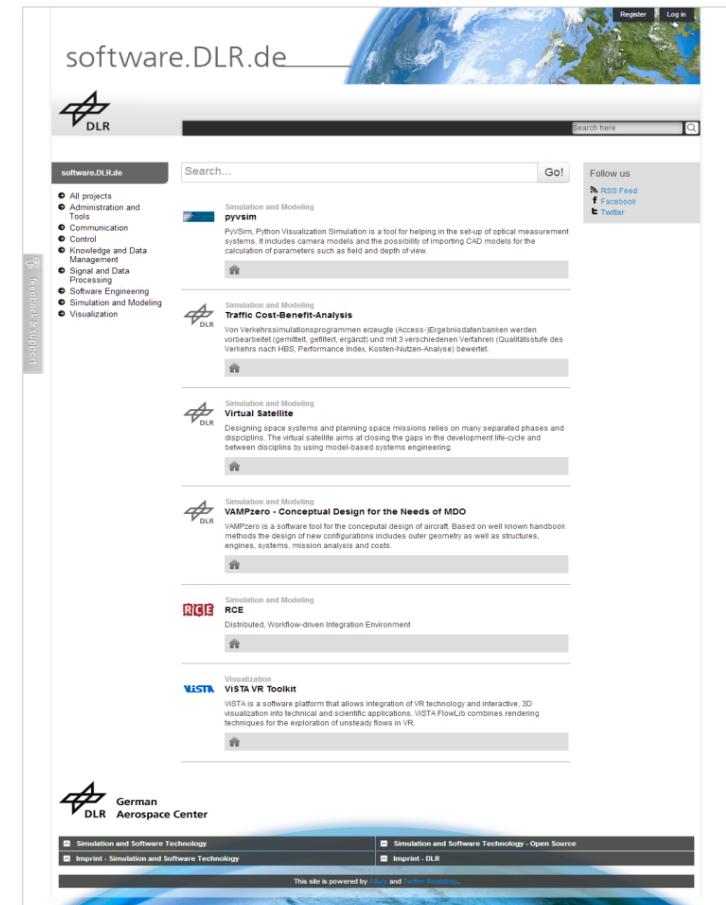
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# Example software.DLR.de

## DLR Software Catalog

- Reduce double developments
- Search for software projects of DLR
- Available for DLR employees and the public
- For Open Source as well as proprietary software





- ➔ All projects
- ➔ Administration and Tools
- ➔ Communication
- ➔ Control
- ➔ Knowledge and Data Management
- ➔ Signal and Data Processing
- ➔ Software Engineering
- ➔ Simulation and Modeling
- ➔ Visualization



## Simulation and Modeling

**pyvsim**

PyVSim, Python Visualization Simulation is a tool for helping in the set-up of optical measurement systems. It includes camera models and the possibility of importing CAD models for the calculation of parameters such as field and depth of view.



## Simulation and Modeling

**Traffic Cost-Benefit-Analysis**

Von Verkehrssimulationsprogrammen erzeugte (Access-)Ergebnisdatenbanken werden vorbearbeitet (gemittelt, gefiltert, ergänzt) und mit 3 verschiedenen Verfahren (Qualitätsstufe des Verkehrs nach HBS, Performance Index, Kosten-Nutzen-Analyse) bewertet.



## Simulation and Modeling

**Virtual Satellite**

Designing space systems and planning space missions relies on many separated phases and disciplines. The virtual satellite aims at closing the gaps in the development life-cycle and between disciplines by using model-based systems engineering.





# software.DLR.de



RCE

Home Add Project...

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Schreiber, Andreas Log out

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» Projects  
» RCE

RCE

Simulation and Modeling

License

OSI-Approved Open Source

Programming Language

Java

Development Status

5 - Production/Stable

Operating System

WinXP  
Windows 7  
Linux

Research Program

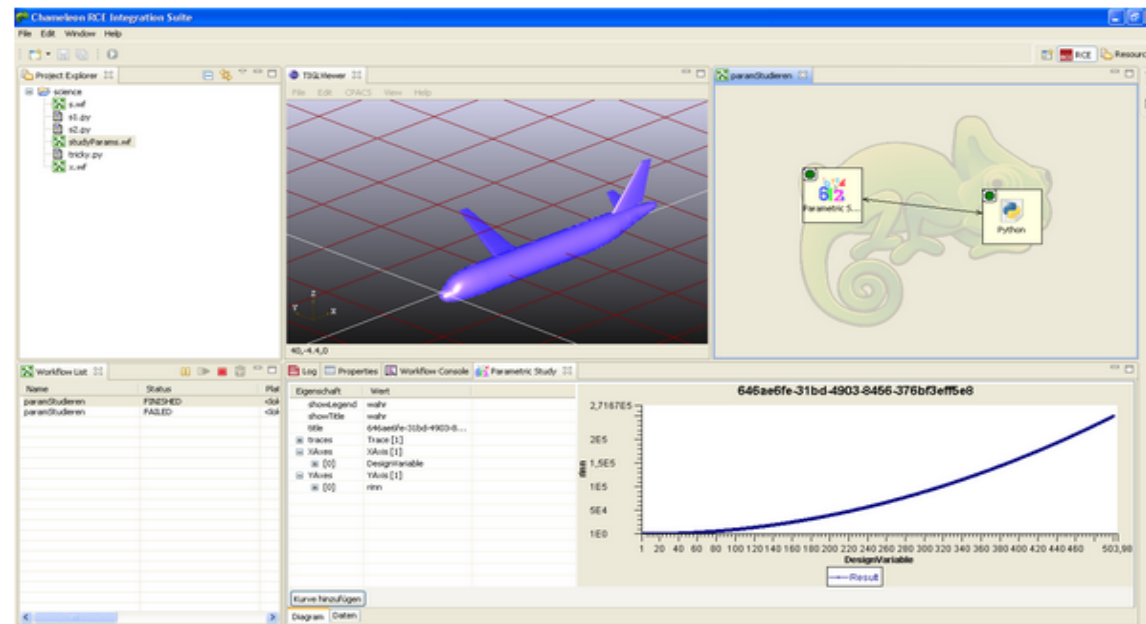
no assignment

Institute

Simulation and Software  
Technology

Site

Cologne



RCE is a distributed, workflow-driven integration environment. We made RCE especially for engineers and scientists to design and simulate complex systems (e.g., aircrafts, ships, or satellites) by using and integrating their own design and simulation tools.

Some application areas of RCE have special needs. Therefore, we realize different RCE editions (Download):

feedback & support



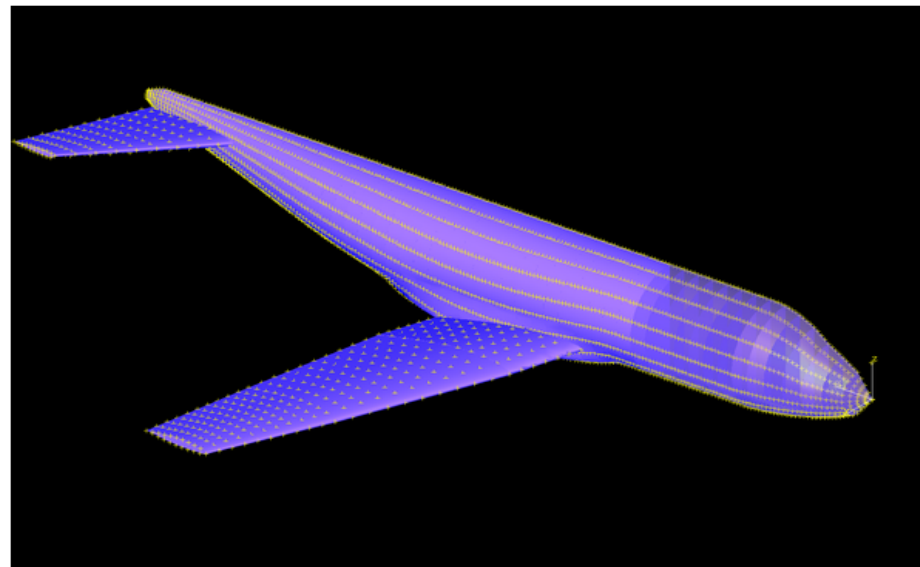
software.DLR.de

» Projects

» TIGL

## TIGL

Visualization



The TIGL Geometry Library can be used for easy processing of geometric data stored inside CPACS data sets. TIGL offers query functions for the geometry structure. These functions can be used for example to detect how many segments are attached to a certain segment, which indices these segments have, or how many wings and fuselages the current airplane configuration contains. This functionality is necessary because not only the modeling of simple wings or fuselages but also the description of quite complicated structures with branches or flaps is targeted. The developed library uses the Open Source software OpenCASCADE to represent the airplane geometry by B-spline surfaces in order to compute surface points and also to export the geometry in the IGES/VTX format. The library provides external interfaces for C, C++, Python, Java and FORTRAN.

## License

OSI-Approved Open Source

## Programming Language

C  
C++  
Python 2  
Fortran

## Development Status

5 - Production/Stable

## Operating System

Windows 7  
Linux

## Research Program

L - no assignment

## Institute

Simulation and Software  
Technology

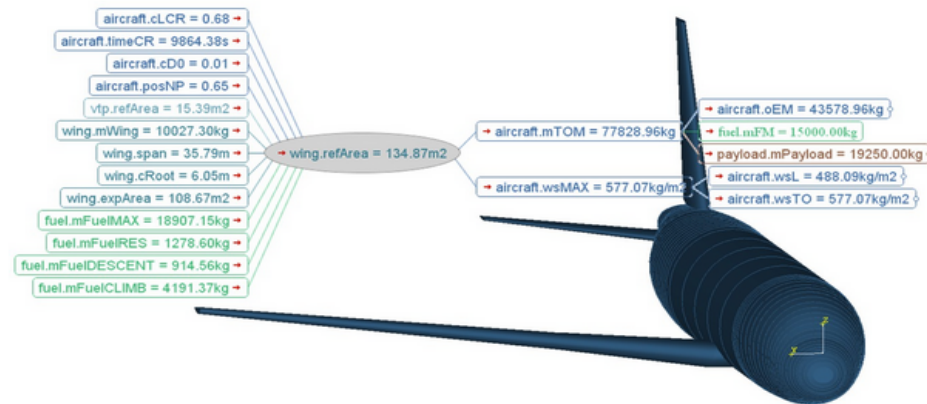
## Site

Cologne



## VAMPzero - Conceptual Design for the Needs of MDO

Simulation and Modeling



VAMPzero is a software tool for the conceptual design of aircraft. Based on well known handbook methods the design of new configurations includes outer geometry as well as structures, engines, systems, mission analysis and costs. It supports working in multi-disciplinary and multi-fidelity environments. VAMPzero can interpret data from CPACS. Even more important VAMPzero can be used to generate CPACS files. Due to the fact that VAMPzero is based on an object oriented structure it is highly flexible. Furthermore, the structure distinguishes feature aspects (file handling, convergence control, process control) and design aspects (parameter definition, calculation methods) in a way that makes extensions easy to implement. The design aspects are grouped into components, disciplines and parameters, where as the parameters contain the actual design knowledge.

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Last update: 2013-03-05

## Project resources

[Support homepage](#)

## Project members

[Root](#)  
[Kunde, Markus](#)  
[Schlauch, Tobias](#)  
[Schreiber, Andreas](#)

## License

OSI-Approved Open Source  
Apache License V2.0

## Programming Language

Python 2

## Development Status

5 - Production/Stable

## Operating System

Windows 7  
Linux

## Research Program

L - no assignment

## Institute

Institute of Air Transportation  
Systems

## Site

Hamburg

# Example

## Provenance of Software Development

### Problem

- Today's software development processes are complex
- Massive interaction between developers and tools as well as between tools (manually or automatically)
- Tracing and understanding the process is hard
- Software isn't reused because of lack of trust and quality

### Solution

- Recording of process information during runtime
- Analysis of recorded information for insight and confidence

### Recording the *Provenance*





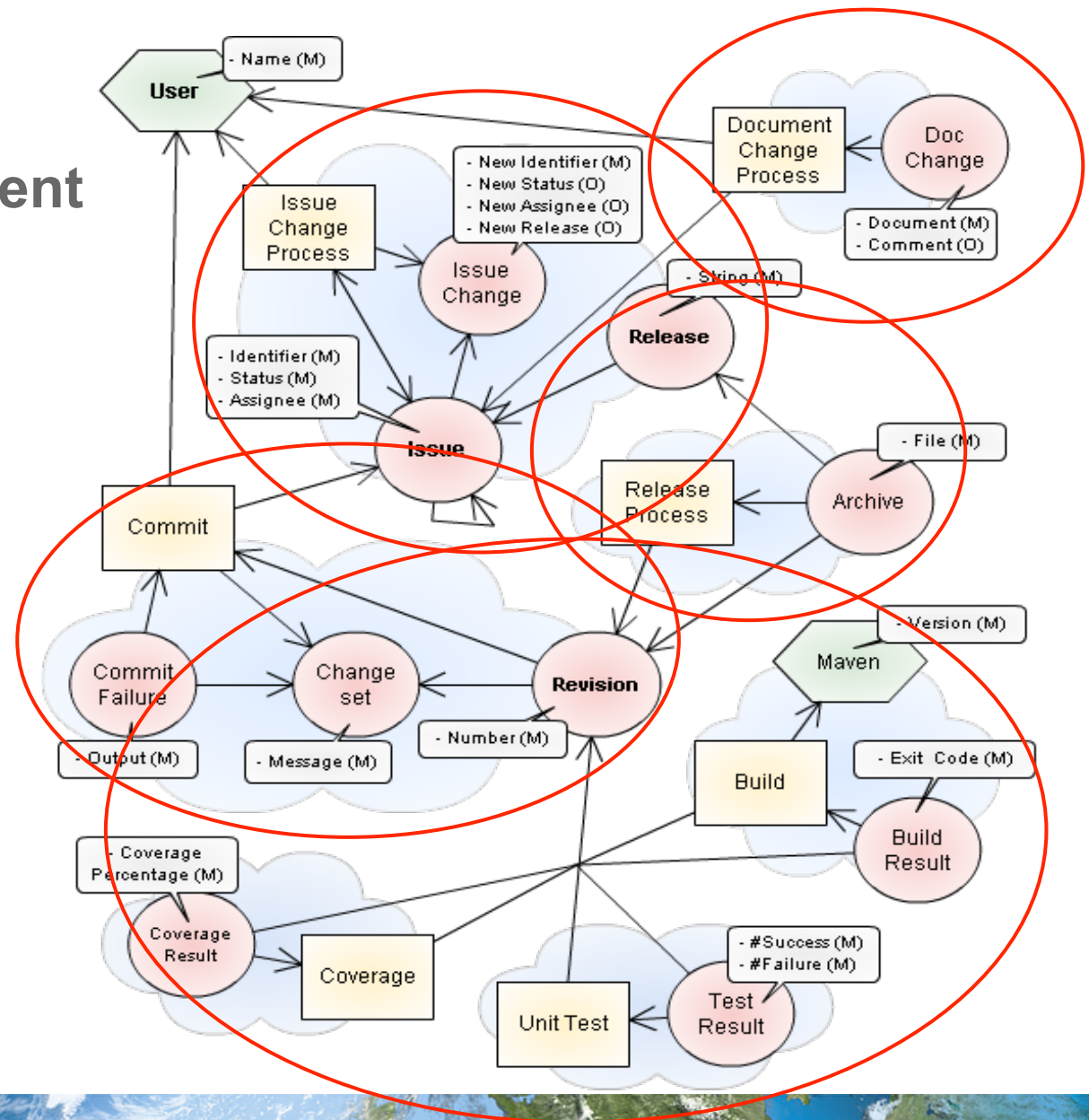
# Provenance of Software Development

## Activities

- Issue Tracking
- Development
- Continuous Integration
- Documentation
- Release

## Entities and Agents

- User
- Issue
- Revision
- Release



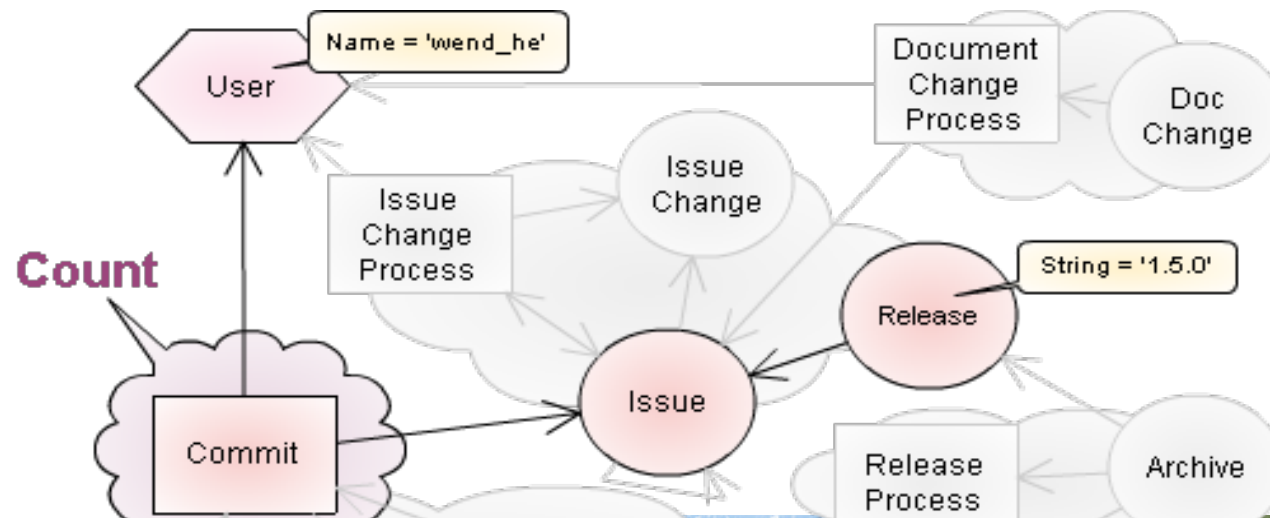
## Questions and Problems

|                    |                     |   |
|--------------------|---------------------|---|
| <b>Single Tool</b> | <b>Simple</b>       | <i>What is the current overall code coverage?</i>                     |
|                    | <b>Aggregated</b>   | <i>How did the number of unit tests change in the last month?</i>     |
| <b>Multi Tool</b>  | <b>Developer</b>    | <i>How many issues were implemented by developer X for release Y?</i> |
|                    | <b>Requirements</b> | <i>How much time has been spent implementing issue X?</i>             |
|                    | <b>Errors</b>       | <i>Which requirement causes the most build failures?</i>              |



## *How many commits did developer X contribute to release Y?*

```
$release := g:key($_g, 'string', string($release))  
$commits := $release/outE/inV/inE/outV[@type='commit']  
$relevant := $commits[outE/inV[@type='user' and  
@name=string($developer)]]  
$count := count($relevant)
```



# High Performance Computing Group





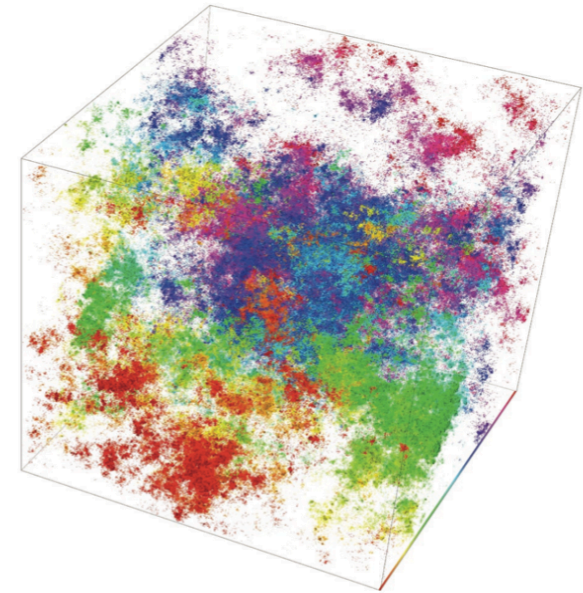
# Group High Performance Computing

## Algorithms and data structures

- Numerical libraries
- Partitioning
- Optimization

## Parallelization techniques for modern architectures

- Parallel communication libraries and languages
- Tools for parallel software systems



## Partner



## Events



### **PyCon.DE 2013**

National Python Developer Conference

- October 2013, Cologne, Germany



### **PyHPC 2013**

Python for High Performance and Scientific Computing

- November 2013, Denver, CO (at SC13)



### **IPAW 2014**

International Provenance and Annotation Workshop

- June 2014, Cologne, Germany



# Contact

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